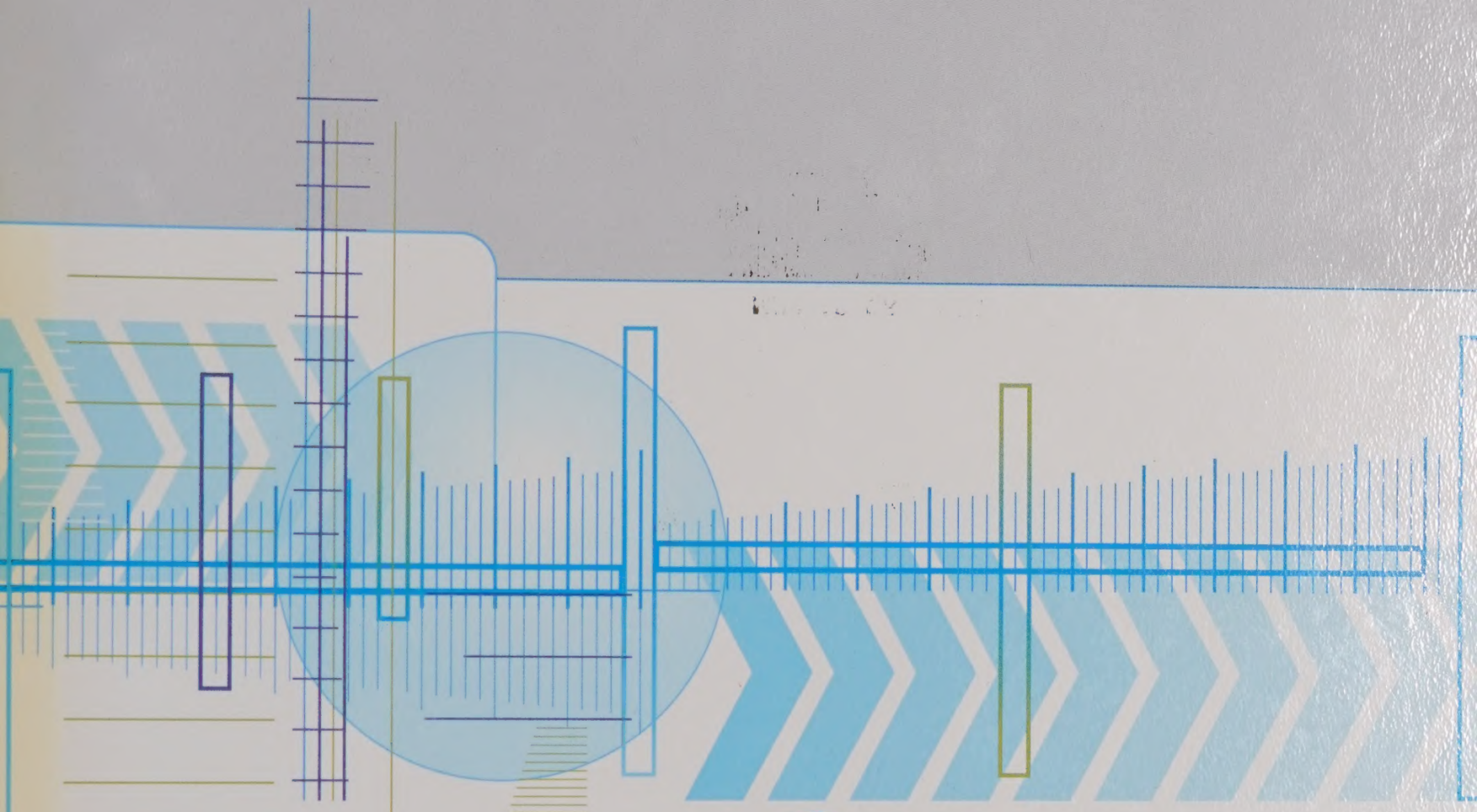

documentation

MP MASTER
MA34503

ROHDE&SCHWARZ

ROHDE&SCHWARZ

Test and Measurement
Division

Manual

Power Sensor Module

R&S® NRP-Z27

DC to 18 GHz / 4 µW to 400 mW

1169.4102.02

R&S® NRP-Z37

DC to 26.5 GHz / 4 µW to 400 mW

1169.3206.02

Printed in Germany

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Trade names are trademarks of the owners.

Operation of the Power Sensor Module R&S NRP-Z27/-Z37 on the R&S NRP base unit

The power sensor module supplied with this manual has firmware version ***01.61*** or later. To operate it on the R&S NRP base unit, all software components installed on the base unit must have version number ***02.00*** or later. If you want to use the distortion compensation (command group: SENSe:RGAMma, see page 6-12), the 'Main Program' must have at least version number ***3.24***.

The version numbers of the software components can be read out under the menu item 'System Info', in the lines 'Main Program', 'Bootloader' and 'Keybd. Ctrl'. For firmware versions earlier than 02.00, the menu item 'System Info' can be found in the File menu; otherwise, in the System menu.

Tabbed Divider Overview

Data Sheet

Safety Instructions
Certificate of Quality
EU Certificate of Conformity
List of R&S Representatives

Tabbed Divider

1	**Chapter 1:**	**Putting into Operation**
2	**Chapter 2:**	**Virtual Power Meter**
3	**Chapter 3:**	**Operation**
4	**Chapter 4:**	for future extensions
5	**Chapter 5:**	**Remote Control – Basics**
6	**Chapter 6:**	**Remote Control – Commands**
7	**Chapter 7:**	for future extensions
8	**Service Instructions**	

Power Meter R&S NRP

in R&S SMART SENSOR TECHNOLOGY

- Innovative multipath sensor technology
- 90 dB dynamic range
- High measurement speed
- Intelligent sensors – simply plug in and measure
- Accurate measurement of average power regardless of bandwidth and modulation
- Multislot measurements for common time division systems (e.g. GSM/EDGE, DECT)
- Handling of external components through Γ and s-parameter correction
- Simultaneous operation of up to 4 sensors on basic unit
- Operation of sensor directly from PC via USB interface
- 2-year calibration cycle

ROHDE&SCHWARZ

Ready for a wide variety of applications

The RF and microwave Power Meter R&S NRP is always the right choice: It is ideal for daily use in research and development, production or mobile service, not to mention when analyzing broadband modulation signals of third-generation mobile radio. The versatility of the novel R&S NRP power meter series is primarily due to the newly developed sensors in R&S SMART SENSOR TECHNOLOGY. These sensors are intelligent standalone instruments that communicate with the basic unit or a PC via a digital interface. The R&S SMART SENSOR TECHNOLOGY, now implemented for the first time, sets new standards in terms of universality and accuracy. The R&S NRP basic unit offers exactly what you expect for today's needs: compact size, intuitive user interface and multichannel capability.

Designed for R&D

Top measurement accuracy plus a dynamic range of 90 dB for broadband signals of any modulation are the most requested characteristics of a modern power meter. The versatile R&S NRP sensors in R&S SMART SENSOR TECHNOLOGY feature exactly these characteristics and are a priceless investment if you wish to meet future requirements such as the broadband modulation types of third-generation mobile radio. In addition, they are also capable of handling the RF bandwidths beyond 100 MHz that are already under discussion for wireless LAN.

A power meter must of course be easy to operate: The numerous sensor functions can be activated via an intuitive user interface, and the high-resolution display indicates up to 4 measurement results at a time. As with other power meters from Rohde&Schwarz, all calibration data is stored in the sensor, which ensures high-precision measurements by minimizing operating errors.

Softkeys and window-oriented menu technique
Power sensor in R&S SMART SENSOR TECHNOLOGY with 90 dB dynamic range
Built-in test generator (option R&S NRP-B1)
Display of up to 4 measurement results
Function keys for fast access to important functions
Sensor connectors on front panel, channel B: option R&S NRP-B2
ROHDE&SCHWARZ
NRP - POWER METER
-20.92 dBm
0.41 dB
NRP-Z21

Ideal for production

If you have ever dealt with microwave power measurements, you know that the necessary filtering of results due to the noise characteristics of the sensor as well as delays in measurement range selection and command/result processing can have negative effects on throughput in production. And this is where the R&S NRP with its innovative features offers straightforward solutions:

- Autofilter
- Parallel processing
- Speed

It goes without saying that the basic unit, which can accommodate up to 4 sensors at the same time, can be fully remote-controlled. In addition, the sensors can directly be connected to a PC. It is good to know that the sensors can perform reliable measurements for an extended period of time owing to the long calibration interval of 2 years.

Mobile use

The handy, lightweight and sturdy instrument, which can also be powered from the optional battery for several hours, makes mobile use a pleasure. With an operating temperature range from 0 °C to 50 °C, the Power Meter R&S NRP can be used under almost any conditions.

R&S SMART SENSOR TECHNOLOGY allows every R&S NRP sensor to be operated directly from a PC, making it the smallest and most lightweight microwave measuring instrument available.

For any type of test signal:

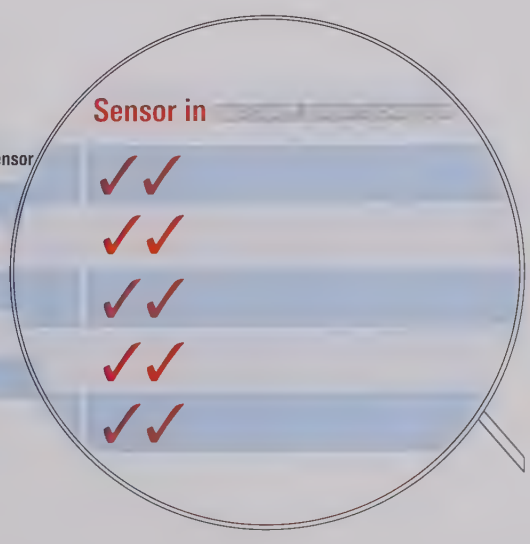
R&S SMART SENSOR TECHNOLOGY

Microwave power meters have historically required a multitude of different sensors to cover all applications. Thermal sensors, diode sensors as well as peak power sensors were used to handle the various measurement tasks. The sensors of the R&S NRP family now make life much easier – in many cases, a single sensor can perform all necessary measurements (see table 1).

Table 1: Sensor technologies and their applications

Application ↓ Sensor →	Thermoelectric sensor	Diode sensor (CW)	Peak power sensor
Average power	✓✓	✓	✓
Burst power	—	—	✓✓
Time gating	—	—	✓✓
Signal with extremely high bandwidth	✓✓	✓	—
Measurement over wide dynamic range	—	✓✓	✓

✓✓ optimal ✓ possible — not possible



Summary

- **One** power sensor
- 90 dB dynamic range
- CW **and** broadband-modulated signals
- Time-gating applications
- High measurement accuracy and speed

High system accuracy through R&S SMART SENSOR TECHNOLOGY

Plug in and measure

The accuracy of microwave power measurements essentially depends on the characteristics of the sensor, but it is impossible to eliminate level, temperature and frequency influences by traditional means. Rohde&Schwarz solved this problem years ago by introducing a novel approach: Measure the deviations of each manufactured sensor from the ideal characteristics and then store the values in the sensor as a data record. This means that you do not have to bother with calibration data. Instead, you simply plug in the sensor and start the measurement, which is a significant advantage in day-to-day work.

High measurement accuracy – even with modulated signals

Benefitting from all the factors described above, Rohde&Schwarz broadband power meters have a very low measurement uncertainty, which is still the decisive argument in their favour. In the past, however, the data sheet specifications of about 2% (0.09 dB) could seldom be achieved in practice. This was due to error sources associated with the test signal or external circuitry: harmonics and nonharmonics, modulation, mismatch of the source, and the influence of attenuators and directional couplers connected ahead of the sensor for level matching.

The R&S NRP sensors represent a big step forward in solving these problems. The concept of R&S SMART SENSOR TECHNOLOGY (see page 5) comprises an entire series of measures intended to make the sensors similar to thermal sensors in behaviour. This includes very accurate measurement of average power, regardless of modulation (FIG 1), as well as high immunity to incorrect weighting of harmonics, spurious and other interference signals. The maximum speed of 1500 measurements per second (in buffered mode, measurement interval 2 x 100 µs) nevertheless equals that of diode sensors.

Precise calibration

A power sensor can only be as good as the measuring instruments used to calibrate it. This is why the standards employed by Rohde&Schwarz are directly traceable to the power standards of the German Standards Laboratory (PTB).

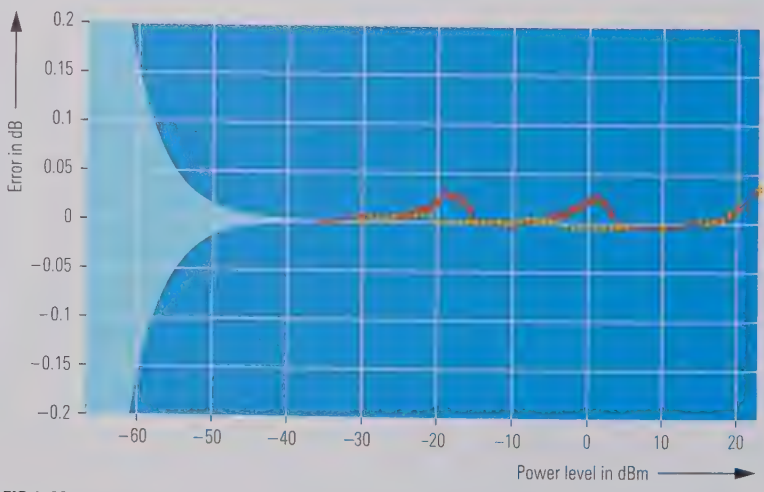


FIG 1: Modulation-related errors of an R&S NRP-Z11 or R&S NRP-Z21 power sensor for a 3GPP test signal (test model 1-64) compared to a CW signal of the same magnitude.
Red: default setting; yellow: transition area between measurement paths shifted by –6 dB; light blue: uncertainty caused by noise (modulation effect below –30 dBm negligible).

R&S SMART SENSOR TECHNOLOGY

The Power Sensors R&S NRP-Z11 and R&S NRP-Z21 fuse multiple-path architecture, multiple-diode technology and a simultaneously scanning multichannel measurement system into a unique high-performance concept.

Multiple-path architecture is the combination of two or three diode detectors to obtain a large dynamic range for modulated signals. This is achieved by operating each detector exclusively in the square-law region and by using only the optimally driven detectors for the measurement.

Multiple diodes comprise several zero-bias Schottky diodes connected in series and integrated on one chip. When used in an RF detector, they expand its square-law region, because the measurement voltage is split among several diodes – so that each one is driven less – while at the same time the detected voltages of the individual diodes are added together.

Rohde&Schwarz's multiple-path architecture (patent pending) is characterized by the following features (FIG 2):

- 3 signal paths, each fitted with triple diodes
- 6 dB wide overlap ranges, smooth transitions
- Simultaneous scanning and analysis
- Chopper stabilization of signal paths for recurring signals

The advantages over conventional technology are obvious: high signal/noise ratio throughout, low modulation effect, negligible delays and discontinuities when switching signal paths, as well as the ability to perform a time-domain analysis of the test signal within the available video bandwidth.

As a consequence, these sensors not only compete with peak power meters – they are indeed superior in two respects:

- No restrictions on the RF bandwidth of the test signal
- Wider dynamic range

As a result, it is already possible today to analyze extremely broadband signals, such as are planned for wireless LAN or will be created by combining several carriers in accordance with 3GPP.

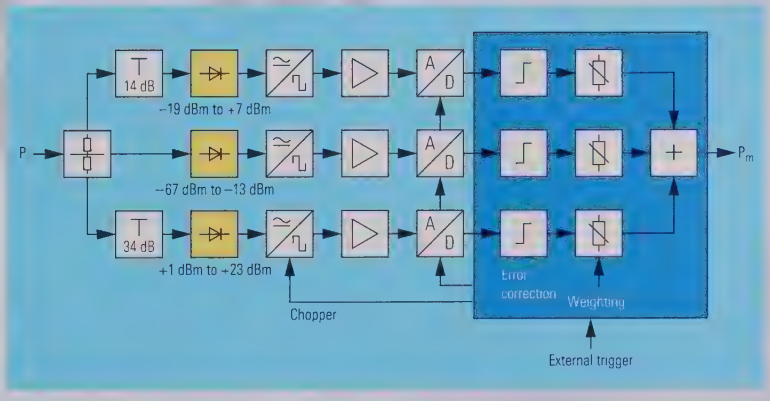


FIG 2: Sensor architecture in R&S NRP-Z11 and R&S NRP-Z21.

Power measurement without external influences

Γ correction – accounting for the source mismatch

The most important source of error in power measurements on RF and microwave signals is the mismatch of source and sensor. Due to reflections that cannot be eliminated, it is not the nominal power P_{GZ0} of the source that is transmitted to the power sensor, but the power P_i (FIG 3) that deviates to a certain extent from the nominal value. To minimize the influence of mismatched sources, the standing wave ratio (SWR) at the sensor end was reduced to the extent technically feasible (1.11). However, a signal source with an SWR of 2, for example, still leads to an additional uncertainty of the measurement result of ±3.5% (0.15 dB). Although this error normally is decisive for total measurement uncertainty, it was frequently not taken into account because it could not be specified for the sensor alone.

Here the R&S NRP sensors boast another innovation: To reduce the mismatch, the complex reflection coefficient of the source is transmitted to the sensor via the USB data interface, and the sensor corrects the matching error by means of Γ correction, taking into consideration its own low impedance mismatch. This approach yields a measurement result of significantly higher precision.

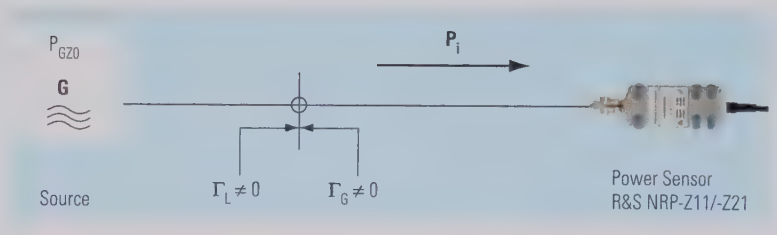


FIG 3: Γ correction function: By taking into account the complex reflection coefficient Γ_G of the source, the measurement result (P_i) is corrected in such a way that the nominal power of the source P_{GZ0} is displayed.

S-parameter correction – accounting for additional components

A similar mismatch problem is encountered in test setups where the sensor cannot be connected directly to the source to be measured. Especially in production facilities, it is often necessary to connect a cable or an attenuator for level matching. In this case, the interactions between three components must be taken into account – a non-trivial bit of mathematics involving complex numbers.

Here, too, the R&S NRP offers a straightforward, standardized solution to the user. With the help of a small software tool that runs on any PC, the complete s-parameter data set of the twoport connected ahead can be loaded into the sensor's memory via the USB data interface.

The data format required (s2p/Touchstone) is provided by any vector network analyzer.

After the source's complex reflection coefficient has been transmitted (optionally), a perfectly corrected reading is obtained; the sensor practically behaves as if it were connected directly to the source (FIG 4).

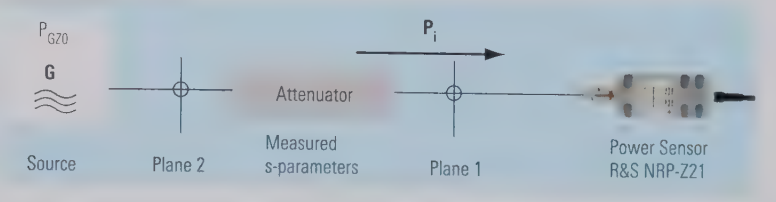


FIG 4: Shifting the measurement plane from 1 to 2 by means of s-parameter correction. The influence of the additional component is compensated for, so that the nominal power P_{GZ0} of the source is measured.

Throughput is essential in production

New autofilter function – averaging made simple

The setting of the display filter is essential for the measurement speed that can be attained. As a rule, noise is superimposed on the signal to be measured. The relative noise content increases as power decreases. To obtain a noise-reduced display, an averaging factor has to be selected for low signal levels, but such a factor increases the measurement time. Therefore a compromise must be made between sufficient signal/noise ratio and acceptable measurement time. The following rule of thumb applies: Reducing the noise by a factor of 10 increases the measurement time by a factor of 100. With the classic autofilter function, the averaging factor is, therefore, only increased gradually, which keeps the measurement time acceptable but does not make it possible to maintain a specific noise level.

The enhanced autofilter function, now implemented in a power meter for the first time, mitigates this problem. In addition to the classic autofilter function, a Fixed Noise mode is available. Using this mode, the sensor will maintain the user-defined S/N ratio as long as the maximum measurement time (to be defined by the user) is not exceeded. Consequently, the instrument provides stable measurement results exactly matched to the user's needs.

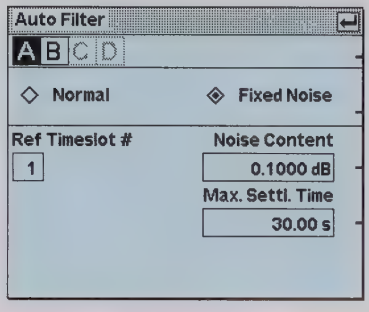


FIG 5: Autofilter menu of the R&S NRP.

Measurement range selection without delay

Multipath concepts for diode sensors often have the disadvantage of hard switching from path A to path B in the case of level changes, which interrupts measurement data acquisition and introduces large differential linearity errors. This disadvantage has been eliminated in the R&S NRP diode sensors in R&S SMART SENSOR TECHNOLOGY owing to parallel signal processing in the three paths and soft transitions from one path to the other.

User-definable measurement window

Measurements on very low-frequency-modulated signals are typically performed using large averaging factors to keep the display stable. This, however, extends the measurement time. The R&S NRP uses a different approach: The measurement time interval is adapted to the signal period by means of windowing. The use of an integer multiple of the period yields a perfectly stabilized measurement result.

High measurement speed

All these requirements, i.e. optimum filtering and fast range selection, must be met before a power meter can make full use of its measurement speed under any conditions. If filtering is not necessary and the size of the measurement window is not critical, the R&S NRP excels with its 1500 measurements per second (in buffered mode, measurement interval 2 x 100 µs).

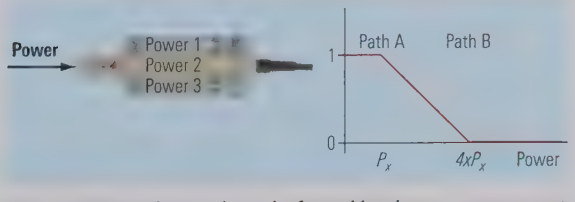


FIG 6: Parallel signal processing and soft transitions between measurement paths owing to R&S SMART SENSOR TECHNOLOGY.

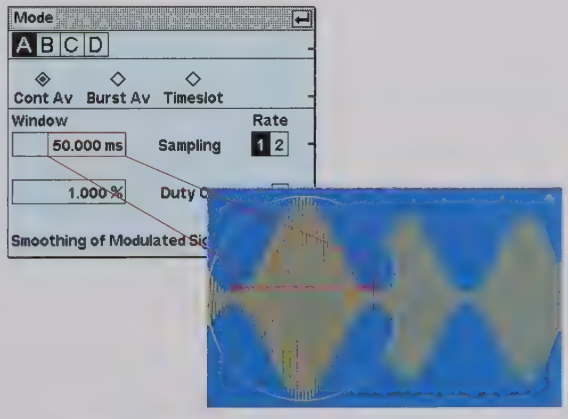


FIG 7: Windowing technique used on a low-frequency-modulated signal.

Signal-synchronized measurements

FIG 8: Modulated burst of an EDGE signal and relevant parameters for measuring burst average power.

Just in time

The R&S NRP-Z11 and R&S NRP-Z21 sensors can measure the average power not only in the classic manner, i.e. continuously without temporal reference to the signal content, but also synchronized with the signal over definable periods of time. Power measurements on signal bursts and within individual timeslots of time division systems are important applications. A fundamental prerequisite for signal-synchronized measurements is the availability of extensive trigger capabilities. The Power Meter R&S NRP can derive the trigger time from the test signal (internal triggering) or from an external trigger signal.

Automatic burst acquisition and measurement

The internal trigger capabilities of the Power Meter R&S NRP are particularly useful for burst measurements. Depending on the trigger level previously defined, the sensor automatically determines the beginning and the end of the burst. This is even accomplished for modulated bursts by defining of a dropout parameter, i.e. a minimum signal-off period that must be detected by the sensor to reliably determine the end of the burst.

In addition, unwanted power components at the beginning or end of the burst can be excluded from the displayed result by using the commands EXCLUDE START and EXCLUDE END (FIG 8).

Multislot measurements

This function enables the R&S NRP to carry out measurements on signals with complex timeslot structure. Up to 128 intervals (26 when controlled by the basic unit) can be acquired and measured at the same time (FIG 9). This allows entire frames of GSM/EDGE signals to be analyzed. The user can select the number and the timing of the timeslots relative to the trigger event; up to 4 results can simultaneously be displayed on the basic unit. The unwanted portions in the transition from one timeslot to the next can be blanked by user-definable exclusion periods.

The internal trigger capabilities of the R&S NRP can also be used in this context. In the case of TDMA signals, using an external frame trigger is often beneficial to generate the temporal relation to timeslot 1. The basic unit is fitted with the appropriate connector on the rear panel; if the sensor is operated from a PC, triggering via the Adapter R&S NRP-Z3 is possible.

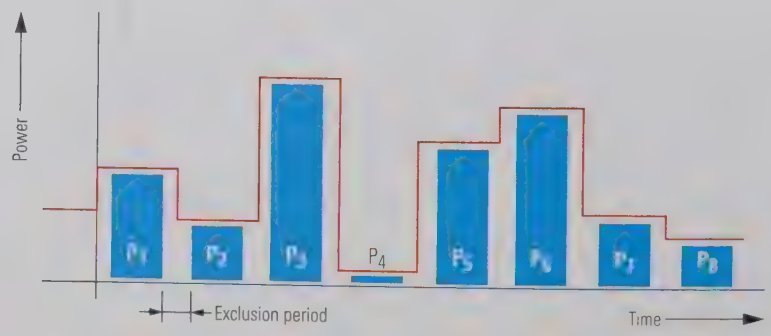


FIG 9: Multislot measurement: for the most common time division methods (e.g. GSM/EDGE, DECT), average power can be measured in all timeslots at the same time.

Power/time template

If the R&S NRP-Z sensors are operated from a PC (see page 10), more in-depth analysis functions are available. Recurring or non-recurring waveforms can be displayed as power/time templates (FIG 10). The number of test intervals (points) can be increased to 1024; signal details down to a duration of about 10 µs can thus be resolved. Extensive trigger functions, derived from an external source or the test signal, again ensure stable conditions.

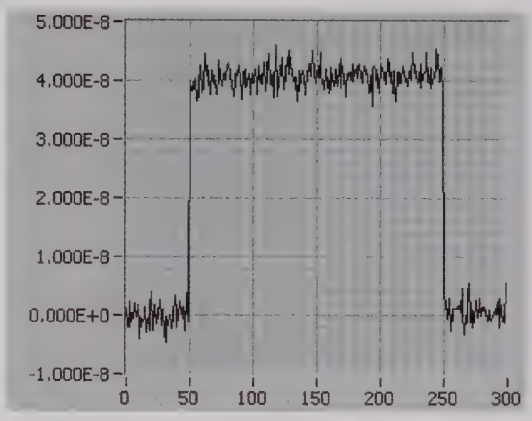


FIG 10: Power/time template of a nonrecurring RF burst for an application in medical electronics, measured with the R&S NRP-Z11 (LabView application without basic unit; readings in W and ms, no averaging).

Outstanding dynamic range

In the past, the limited dynamic range of standard sensor technologies forced many users to employ sensors of different sensitivity (nominal power) to handle the power range of the test items. This was especially true if average power of modulated signals had to be measured. Although conventional multipath sensors were able to attain respectable values, their dynamic range was limited to 80 dB, not to mention the slow response times and the significant measurement errors in the transition regions of the individual paths. The R&S NRP-Z11 and R&S NRP-Z21 are the first sensors with outstanding values: For the first time, a dynamic range of 90 dB for broadband signals of any modulation has been achieved, while the lower measurement limit (defined by noise and zero offset) remains a very respectable –67 dBm. With signal-synchronized measurements, the difference between the new sensors and previous power sensors is most evident.

For signal-triggered measurements of the average power of single bursts or the generation of a power/time template, a wider dynamic range is available than with all existing conventional designs.

Table 2: Dynamic range for measuring average power (bandwidth of test signal 100 MHz/5 MHz/0 (CW))

Technology ↓	Mode ↓			
	Continuous	**Timeslot** 1 out of 8 (external trigger)	**Burst** duty cycle 1:8 (internal trigger)	**Power versus time** 256 points (external trigger)
Thermoelectric sensor	50/50/50 dB	–	–	–
Diode: Sensor in square-law region	43/43/50 dB	–	–	–
Diode: CW sensor	43/43/90 dB	–	–	–
Diode: Peak sensor	33/50/80 dB	–/50/57 dB	–/33/37 dB	–/50/57 dB
Diode: Multiple-path sensor	80/80/80 dB	–	–	–
Diode: R&S SMART SENSOR TECHNOLOGY	**90/90/90 dB**	**85/85/85 dB**	**60/60/60 dB**	**70/70/70 dB**

Sensor with PC interface

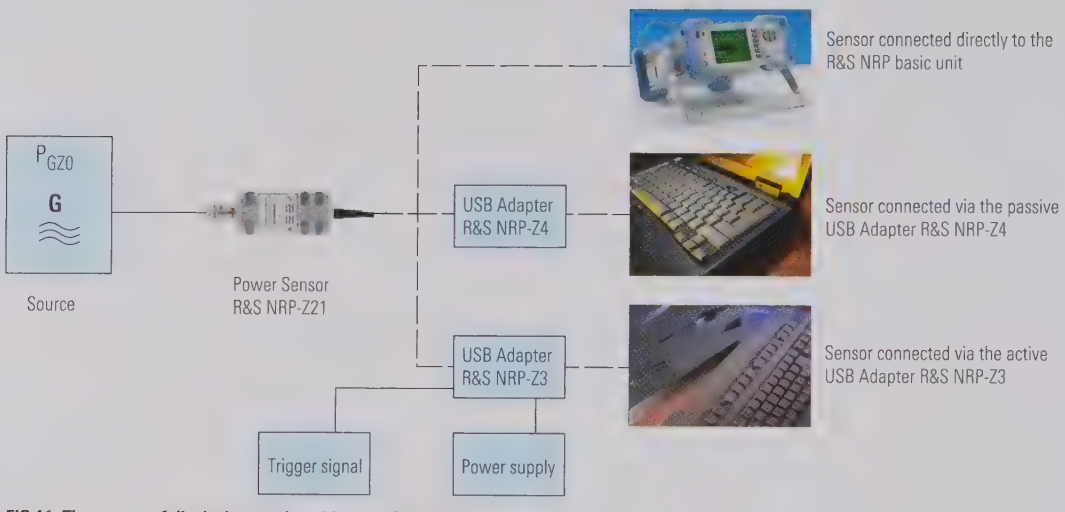

Sensor connected directly to the R&S NRP basic unit
P_{GZ0}
G
Source
Power Sensor R&S NRP-Z21
USB Adapter R&S NRP-Z4
Sensor connected via the passive USB Adapter R&S NRP-Z4
USB Adapter R&S NRP-Z3
Sensor connected via the active USB Adapter R&S NRP-Z3
Trigger signal
Power supply

FIG 11: Three ways of displaying results with an R&S NRP sensor.

Miniature power meter

The sensors of the R&S NRP-Z series can be used as standalone measuring instruments without the basic unit. In addition to the power sensor itself, they include a CPU that controls the sensor, processes the measurement results and operates the interface: a complete miniature power meter. All measurement data and settings are transmitted via a digital USB interface. This concept, with which Rohde&Schwarz already set the pace in the field of directional power meters, is now being used for the first time in classic microwave power measurements.

Use on a PC

The most cost-effective method for high-precision power measurements is to connect the sensors directly to a PC, especially if data acquisition and evaluation take place via a PC. The main area of application is production, since production environments usually include a process controller. The fact that the basic unit can be omitted saves space in the rack and reduces costs.

Service technicians will also appreciate this option since the power meter fits into a trouser pocket and can easily be operated from a laptop.

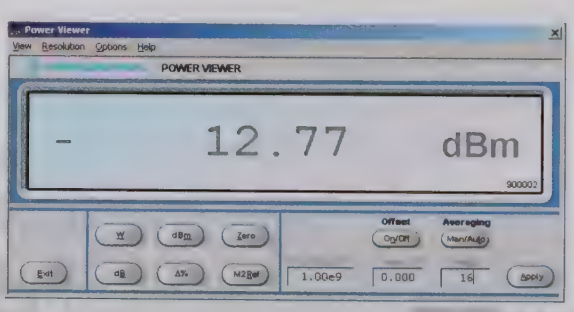


FIG 12: The Power Viewer turns any PC (under Windows 98/2000/ME/XP) into a power meter.

The software toolkit supplied as standard with every R&S NRP sensor is required in order to control the R&S NRP power sensors via a PC. The software toolkit comes with both a DLL (dynamic link library), for individualized use of the entire sensor functionality under Windows, and the Power Viewer, a virtual power meter with basic measurement functions (subset of the R&S NRP functionality) for the PC workstation (FIG 12).

Two adapters are available for connection to the hardware:

- The passive USB Adapter R&S NRP-Z4 provides all basic functions, as it handles the transmission of settings and measurement data as well as the power supply of the sensor.
- The active USB Adapter R&S NRP-Z3 has been developed for applications requiring external triggering of the power sensor. It also offers a separate power supply.

Universal basic unit

For applications requiring a basic unit, the R&S NRP offers everything that is expected from a modern power meter – and much more. It is small, lightweight and rugged, and the optional battery pack ensures several hours of operation without line power. Depending on requirements, it can be fitted with one, two or four measurement inputs (options R&S NRP-B2 and R&S NRP-B5).
The IEC/IEEE bus connector is a standard feature as are the trigger input and the analog measurement output.

The user interface of the power meter takes its cue from the PC world: The basic unit is controlled via menu bars, menus and dialog boxes, and uses only three menu levels despite the large number of functions. The self-explanatory operating concept makes the R&S NRP a pleasure to use.

The high-resolution graphical display can show as many as four measurement results at the same time. The user can choose which results to display – either the data from different sensors (with a maximum of four connected simultaneously) or from different timeslots of a TDMA signal measured by means of one sensor. Even values obtained by calculation, such as SWR or return loss, can be displayed. For immediate clarity, each data window can be assigned a specific name.

FIG 13: The Power Meter R&S NRP can be equipped with one, two or four measurement inputs (two on rear panel, see red frame).

Specifications

Power Sensors R&S NRP-Z11/-Z21 (specifications from 8 GHz to 18 GHz apply only to R&S NRP-Z21)

Bold: Parameter 100% tested.
Italics: Uncertainties calculated from the test assembly specifications and the modelled behaviour of the sensor.
Normal: Compliance with specifications is ensured by the design or derived from the measurement of related parameters.

Sensor type	3-path diode sensor
Measurand	average power of incident wave or average power of source into 50 Ω[1]
Frequency range	10 MHz to 8 GHz (R&S NRP-Z11) 10 MHz to 18 GHz (R&S NRP-Z21)
Matching (SWR)	values in () for temperature range 15 °C to 35 °C
10 MHz to <30 MHz	<1.15 **(1.13)**
30 MHz to 2.4 GHz	<1.13 **(1.11)**
>2.4 GHz to 8.0 GHz	<1.20 **(1.18)**
>8.0 GHz to 18.0 GHz	<1.25 **(1.23)**
Level-dependent matching change[2]	
10 MHz to 2.4 GHz	<0.05 (0.02)
>2.4 GHz to 18.0 GHz	<0.10 (0.07)
RF connector	N (male)

Power measurement range

Continuous Average	200 pW to 200 mW (–67 dBm to +23 dBm)
Burst Average	200 nW to 200 mW (–37 dBm to +23 dBm)
Timeslot	650 pW to 200 mW (–62 dBm to +23 dBm)[3]
Scope	10 nW to 200 mW (–50 dBm to +23 dBm)[4]

Max. power

Average	0.4 W (+26 dBm) continuous
Peak envelope power	1.0 W (+30 dBm) for max. 10 µs

Measurement subranges

Path 1	–67 dBm to –14 dBm
Path 2	–47 dBm to + 6 dBm
Path 3	–27 dBm to +23 dBm

Transition ranges

With automatic path selection, user def'd crossover[5] set to 0 dB	(–19 ±1) dBm to (–13 ±1) dBm (+1 ±1) dBm to (+7 ±1) dBm

Measurement functions

Stationary and periodically modulated signals	Continuous Average Burst Average Timeslot Scope[6]
Non-recurring waveforms	Scope[6]

Continuous Average function

Continuous measurement of average power	
Measurement window[7]	2 x (10 µs to 300 ms)
Duty cycle correction[8]	0.001% to 100.00%
Smoothing	see under Measurement window (page 13)
Capacity of measurement buffer[9]	1 to 1024 results

Burst Average function

Measurement of average burst power with automatic detection of burst (trigger settings required)	
Detectable burst width	20 µs to 100 ms
Minimum gap between bursts	10 µs
Dropout tolerance[10]	0 ms to 3 ms
Exclusion periods[11]	
Excluded from Start	0 ms to 100 ms
Excluded from End	0 ms to 3 ms
Measurement window[7]	2 x (burst width – Excl. from Start – Excl. from End)

Timeslot function

Measurement of average power in one or more equidistant, successive timeslots	
Duration (nominal width)	10 µs to 100 ms
Number of timeslots	1 to 128 (26 in case of operation from R&S NRP basic unit)
Exclusion periods[11]	
Excluded from Start	0 ms to 100 ms
Excluded from End	0 ms to 3 ms
Measurement window (per timeslot)[7]	2 x (nom. width – Excl. from Start – Excl. from End)

Scope function

Measurement of power versus time	
Modes	for recurring and non-recurring waveforms (single)
Measurement window Δ[12]	
Recurring	2 x (100 µs to 300 ms)
Non-recurring	100 µs to 300 ms
Number of measurement points M	1 to 1024
Resolution Δ/M	≥10 µs
Beginning of measurement window (referenced to trigger)	–5 ms to 100 s

Dynamic behaviour of video path	values in () for temperature range 15 °C to 35 °C
Bandwidth	>50 kHz (100 kHz)
Rise time 10%/90%	<8 µs (4 µs)

Sampling frequencies

Frequency 1 (default)	133.358 kHz
Frequency 2[13]	119.467 kHz

Display noise[14] values in []: 8 GHz to 18 GHz

15 °C to 35 °C	Path 1	<60 pW [64 pW] (40 pW typ.)
	Path 2	<5.6 nW [6.0 nW] (3.6 nW typ.)
	Path 3	<0.56 µW [0.60 µW] (0.36 µW typ.)
0 °C to 50 °C	Path 1	<65 pW [69 pW]
	Path 2	<6.3 nW [6.6 nW]
	Path 3	<0.63 µW [0.66 µW]

Display noise, relative[15]

Measurement window 2 x 100 µs, without averaging	<0.160 dB (0.1 dB typ.)
Measurement window 2 x 20 ms, averaging factor 32 (measurement time approx. 1 s)	<0.002 dB (0.001 dB typ.)

Zeroing (duration)

Depends on setting of averaging filter		
AUTO ON		4 s
AUTO OFF		
Integration time[16]	<4 s	4 s
	4 s to 16 s	integration time[16]
	>16 s	16 s

Zero offset[17]

values in []: 8 GHz to 18 GHz

15 °C to 35 °C	Path 1	<96 pW [102 pW] (64 pW typ.)
	Path 2	<9.0 nW [9.6 nW] (5.8 nW typ.)
	Path 3	<0.90 µW [0.96 µW] (0.58 µW typ.)
0 °C to 50 °C	Path 1	<104 pW [110 pW]
	Path 2	<10.0 nW [10.6 nW]
	Path 3	<1.00 µW [1.06 µW]

Zero drift[18]

values in []: 8 GHz to 18 GHz

Path 1	<35 pW [37 pW]
Path 2	<3.0 nW [3.2 nW]
Path 3	<0.30 µW [0.32 µW]

Measurement error due to harmonics $n \times f_0$ of carrier frequency[19]

Values in []: typ. standard uncertainty

n = 3, 5, 7, ...[20]	–30 dBc	<0.003 dB [0.0015 dB]
	–20 dBc	<0.010 dB [0.005 dB]
	–10 dBc	<0.040 dB [0.015 dB]
n = 2, 4, 6, ...[20]	–30 dBc	<0.001 dB [0.0003 dB]
	–20 dBc	<0.002 dB [0.001 dB]
	–10 dBc	<0.010 dB [0.003 dB]

Modulation influence[21]

values in []:
User def'd crossover ≤–6 dB

General	measurement errors in subranges are proportional to power and depend on CCDF and modulation bandwidth of test signal
WCDMA (3-GPP Test Model 1-64)	
Worst case	–0.02 dB to +0.07 dB [–0.02 dB to +0.02 dB]
Typical	–0.01 dB to +0.03 dB [–0.01 dB to +0.01 dB]

Averaging filter

Modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)
AUTO mode	
Reference power	
Continuous Average	non-averaged result in measurement window
Burst Average	non-averaged result in measurement window
Timeslot	non-averaged result in reference timeslot[25]
Scope[22]	non-averaged result at reference point[25]
Normal operating mode[23]	setting of filter depends on power to be measured and resolution
Resolution	1 (1 dB), 2 (0.1 dB), 3 (0.01 dB), 4 (0.001 dB)
Fixed Noise operating mode	filter set to specified noise content
Noise content	0.0001 dB to 1 dB
Max. measurement time[24]	0.01 s to 999 s
Averaging factor N	1 to 2^{16} (number of averaged measurement windows)
Result output	
Moving Average	continuous with every newly evaluated measurement window (e.g. in case of manual operation via R&S NRP)
Repeat	only final result (e.g. in case of remote control of R&S NRP)

Measurement window

Duration	as specified for the individual measurement functions
Shape	rectangular (integrating behaviour; available for all measurement functions) Von Hann (smoothing filter, for efficient suppression of result variations due to modulation[26]; only for Continuous Average function)

Measurement times[27]

Continuous Average	N x (duration of measurement window[7] + 0.2 ms) + t_z
Buffered, without averaging	buffer size x (duration of measurement window[7] + 0.5 ms) + t_z
Burst Average	(2 to 4) x N x burst period + t_z
Timeslot, Scope	(2 to 4) x N x trigger period + t_z[28] t_z: <1.6 ms (0.9 ms on average)

Triggering

Source	Bus, External, Hold, Immediate, Internal
Slope (external, internal)	pos./neg.
Level	
Internal	–40 dBm to +23 dBm
External	see specs of R&S NRP and USB Adapter R&S NRP-Z3
Delay	–5 ms to +100 s
Holdoff	0 s to 10 s
Hysteresis	0 dB to 10 dB

Attenuation correction

Function	correcting the measurement result by means of a fixed factor (dB offset)
Range	–100.000 dB to +100.000 dB

S-parameter correction

Function	taking into account a component connected ahead of the sensor by loading its s-parameter data set into the sensor
Number of frequencies	1 to 1000
Parameters	s_{11}, s_{21}, s_{12} and s_{22} (in s2p format)
Download	with R&S NRP toolkit (supplied with sensor) via USB Adapter R&S NRP-Z3 or R&S NRP-Z4

Γ correction

Function	reducing the influence of mismatched sources[29]
Parameters	magnitude and phase of reflection coefficient of source
Download	see under S-parameter correction

Frequency response correction

Function	taking into account the calibration factors relevant for the test frequency
Parameter	carrier frequency (center frequency)
Permissible deviation from actual value	50 MHz (0.05 x f below 1 GHz) for specified measurement uncertainty

Inputs/outputs (rear panel)	
OUT1	
Modes	Analog, Pass/Fail, Off
Analog	recorder output; user-definable linear relation to measurement result (display windows 1 to 4)
Pass/Fail	limit indicator with two user-selectable voltages for identifying the Pass and Fail states in the case of limit monitoring
Off	0 V
Voltage range	0 V to +3.3 V
Setting accuracy	±1% of voltage reading + (0/+8 mV)
Resolution	12 bit (monotone)
Output impedance	1 kΩ
Connector	BNC (female)
IN/OUT 2	
Modes	Analog Out and Trigger In
Analog Out	recorder output; user-definable linear relation to measurement result (display windows 1 to 4)
Electrical characteristics	see OUT1
Trigger In	input for trigger signal to sensors
Maximum voltage	–7 V/+10 V
Logic level	
Low	<0.8 V
High	>2.0 V
Impedance	10 kΩ//100 pF
Connector	BNC (female)
Power supply	
Voltage, frequency	220 V to 240 V, 50 Hz to 60 Hz 100 V to 120 V, 50 Hz to 400 Hz
Tolerance	±10% for voltage and frequency
Apparent power	<80 VA
Dimensions (W x H x D)	274 mm x 112 mm x 267 mm
Weight	<3.0 kg

Options for R&S NRP

R&S NRP-B1

Power reference	
Power	1.00 mW
Uncertainty	
20 °C to 25 °C	*0.85%*
0 °C to 50 °C	*1.00%*
Frequency	50 MHz
SWR	<1.05 typ.
RF connector	N (female)

R&S NRP-B2

Second test input (B)	for R&S NRP-Z sensors (available as standard on front panel)

R&S NRP-B5

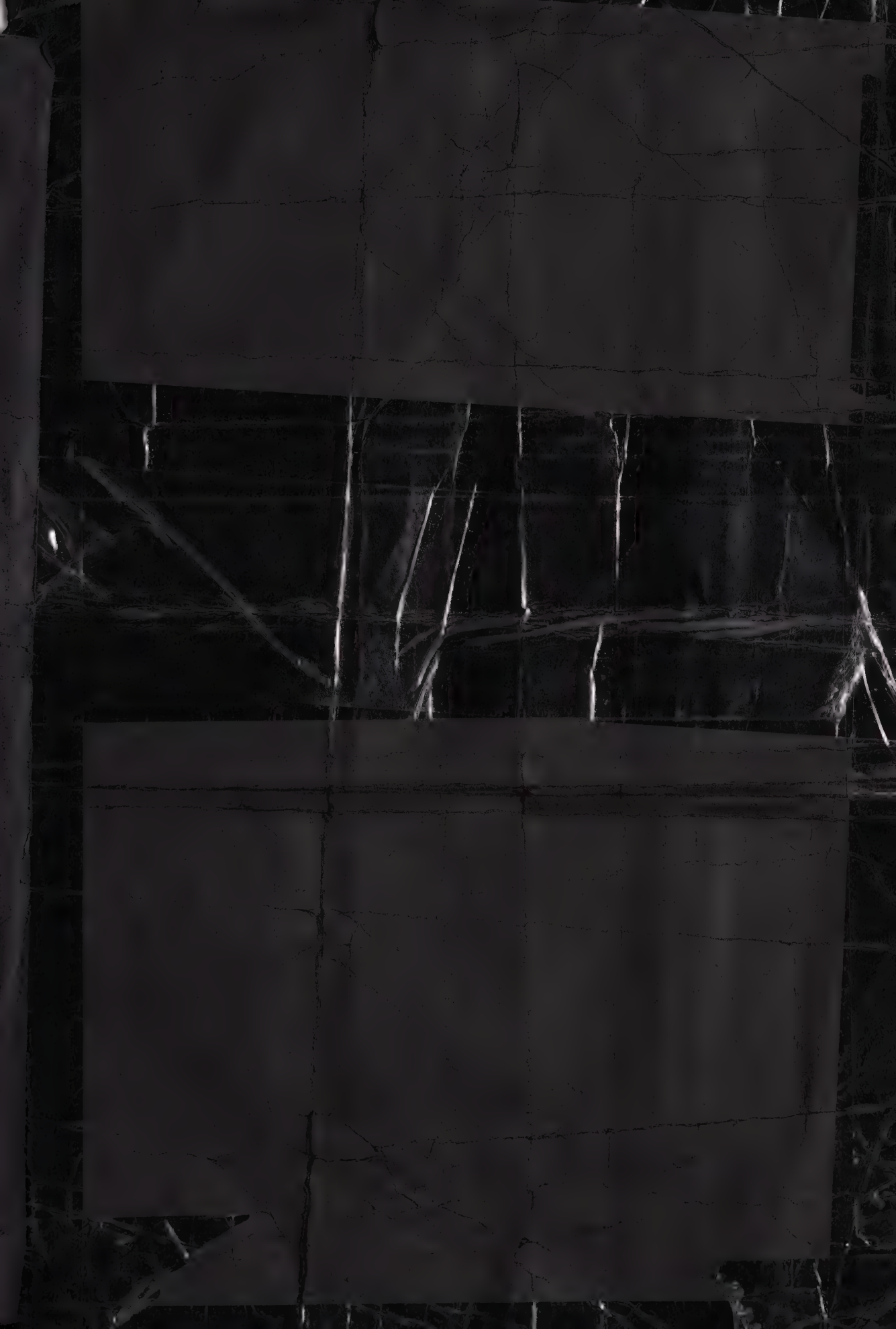
Third (C) and fourth (D) test inputs	for R&S NRP-Z sensors (only on rear panel)

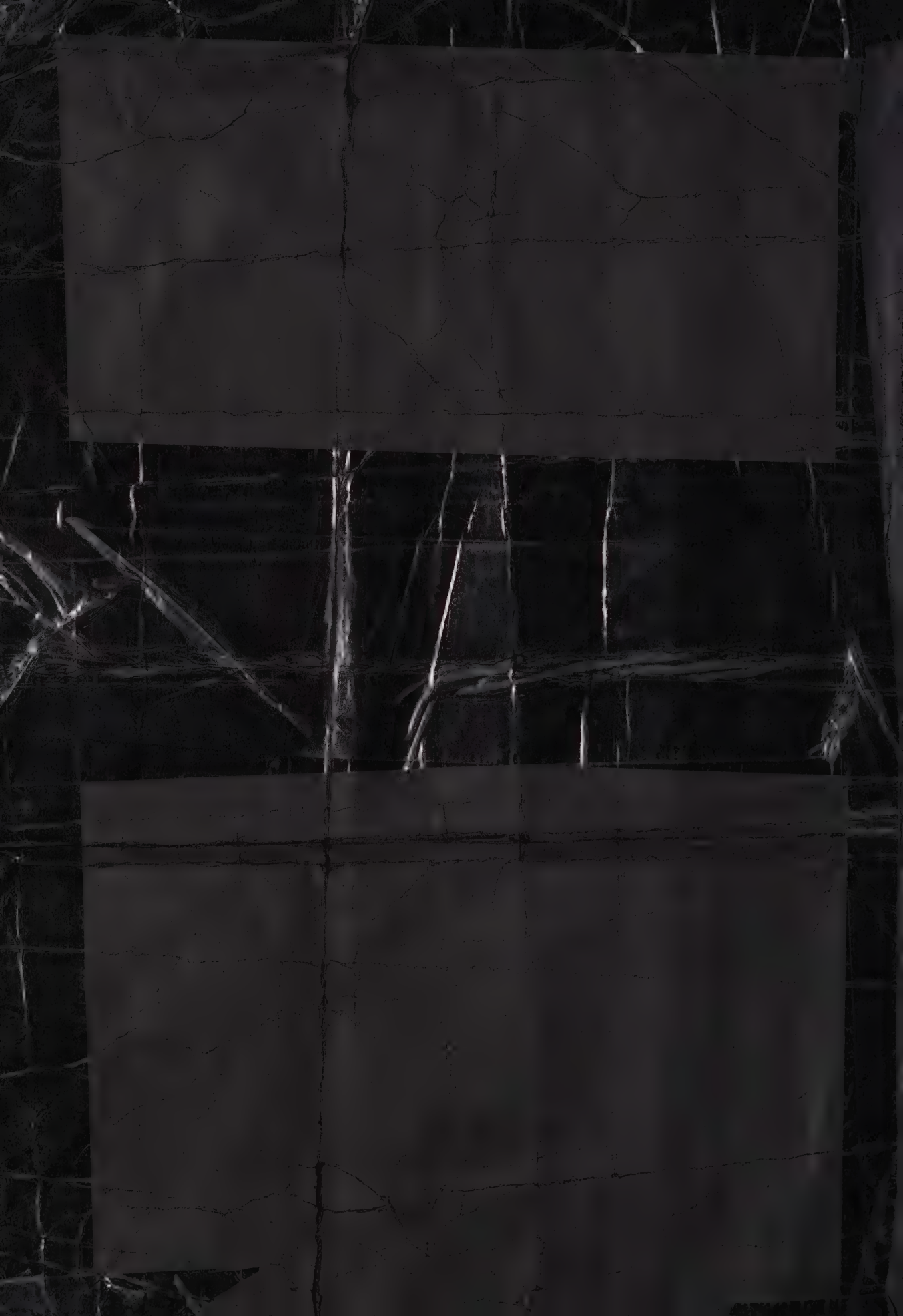
R&S NRP-B6

Rear-panel assembly	for test inputs A and B (only possible if the R&S NRP-B5 option is not installed)

General specifications

Temperature loading[35]	
Operating range and permissible range (in [] if different)	meet IEC 60068
R&S NRP with options	0 °C [–5 °C] to +50 °C
R&S NRP-Z2, -Z11, -Z21	0 °C [–10 °C] to +50 °C [+55 °C]
R&S NRP-Z3	0 °C to +40 °C
Storage range	
R&S NRP with options	–20 °C to +70 °C
R&S NRP-Z2, -Z3, -Z11, -Z21	–40 °C to +70 °C
Climatic resistance	meets IEC 60068
Damp heat	+25 °C/+40 °C cyclic at 95% relative humidity
R&S NRP-Z3, -Z11, -Z21	with restrictions: non-condensing
Mechanical resistance	
Vibration, sinusoidal	meets IEC 60068 5 Hz to 55 Hz, max. 2 g 55 Hz to 150 Hz, 0.5 g constant
Vibration, random	meets IEC 60068 10 Hz to 500 Hz, 1.9 g (rms)
Shock	meets IEC 60068; 40 g shock spectrum
Air pressure	
Operation	795 hPa (2000 m) to 1060 hPa
Transport	566 hPa (4500 m) to 1060 hPa
Electromagnetic compatibility	meets EN 61326, EN 55011
Safety	meets EN 61010-1





1) Γ correction activated.

2 Referenced to 0 dBm.

3) Specifications apply to timeslots with a duration of 12.5% referenced to the signal period (duty cycle 1:8). For other waveforms the following equation applies:
lower measurement limit = 200 pW x $\sqrt{\text{measurement time/integration time}}$
For measurement time, see specifications. For integration time, see footnote [16].

4) With a resolution of 256 points.

5) Transition regions can be shifted by up to –20 dB if automatic path selection has been chosen.

6) The Scope function will be available for the R&S NRP basic unit as of spring 2003.

7) Portion of signal that is the subject of measurement (sampling). The factor of 2 is due to the measurement being performed in two equal periods of time (chopper amplifier) separated by 100 µs. If averaging is activated, the averaging factor determines the number of measurement windows to be averaged.

8) For calculating the pulse power of periodic bursts from an average power measurement.

9) To increase measurement speed, the power sensor can be operated in buffered mode. In this mode, measurement results are stored in a buffer of user-definable size and then output as a block of data when the buffer is full. To enhance measurement speed even further, the sensor can be set to record the entire series of measurements when triggered by a single event. In this case the power sensor automatically starts a new measurement as soon as it completes the preceding one.

10) This parameter enables power measurements on modulated bursts. The parameter must be longer in duration than modulation-induced power drops within the burst, but at least 10 µs shorter than the gap between the end of one burst and the beginning of the next one.

11) To exclude unwanted portions at the beginning or end of the measurement window from the measurement result.

12) Portion of signal that is the subject of measurement (sampling). Periodic signals are measured in two equal periods of time (chopper amplifier) separated by 100 µs. If averaging is activated, the averaging factor determines the number of measurement windows to be averaged.

13) To prevent aliasing in the case of signals with discrete modulation frequencies between 100 kHz and 1 MHz.

14) Two standard deviations, 10.24 s integration time (see footnote [16]). Multiplying noise specifications by $\sqrt{10.24\ \text{s/integration time}}$ yields the noise contribution at other integration times. Smoothing (see under Measurement window) increases noise by 22%.

15) Two standard deviations, for power levels greater than 500 nW (–33 dBm) in Continuous Average mode with automatic path selection (User def'd crossover deactivated or set to 0 dB). Within a measurement subrange, relative measurement uncertainty due to noise is inversely proportional to the measured power. The specified values refer to 500 nW (–33 dBm) and the lower limits of paths 2 and 3 at 50 µW (–13 dBm) and 5 mW (+7 dBm) respectively.

16) Integration time is defined as the total time used for sampling the signal. It can be calculated by multiplying the duration of the measurement window by the averaging factor.

17) Expanded uncertainty (k = 2) after zeroing (for 4 s). Zeroing for more than 4 s lowers uncertainty correspondingly (half values for 16 s).

18) Within 1 hour after zeroing, permissible temperature change ±1 °C, following 2-hour warm-up of power sensor.

19) Magnitude of measurement error with reference to an ideal thermal power sensor that measures the sum power of carrier and harmonics. Specified values apply to automatic path selection (User def'd crossover deactivated or set to 0 dB) and power levels up to +20 dBm. Above +20 dBm, specified values must be multiplied by a factor of 1.25 per 1 dB rise in power level. Within a measurement subrange, errors (uncertainties) are proportional to the measured power in W. The specified values refer to 10 µW (–20 dBm) for path 1, 1 mW (0 dBm) for path 2 and 100 mW (20 dBm) for path 3.

20) Adhering to specified error limits implies that harmonics above 25 GHz (R&S NRP-Z11) and 56 GHz (R&S NRP-Z21) are at least 20 dB lower than required at other frequencies.

21) Measurement error with reference to CW signal of equal power and frequency. Specified values apply to automatic path selection (User def'd crossover deactivated or set to specified value) and power levels up to (+20 dBm + User def'd crossover). Above this level, specified values must be multiplied by a factor of 1.25 per 1 dB rise in power level. In the measurement subranges, the specified values apply to –20 dBm for path 1, 0 dBm for path 2 and +20 dBm for path 3

22) The AUTO mode is not available in conjunction with the R&S NRP basic unit.

23) Characteristics like for a conventional power meter. The averaging factor increases continuously as power decreases, but not to the extent that would be necessary to keep the relative noise content at the same level.

24) Limits the averaging factor when measuring very low powers or when the noise content is set to a very small value (status information available).

25) Reference timeslot and reference point are user-definable.

26) Preferably used with determined modulation, when the duration of the measurement window cannot be matched to the modulation period. Compared to a rectangular window, display noise is about 22% higher.

27) Valid for Repeat mode, extending from the beginning to the conclusion of all transfers via the USB interface of the power sensor. Measurement times under remote control of the R&S NRP basic unit via IEC/IEEE bus are approximately 2.5 ms longer, extending from the start of the measurement until the measurement result is supplied to the output buffer of the R&S NRP.

28) For calculation of measurement time, N must be set to twice the averaging factor if the expression (number of timeslots x nominal width + 100 µs + trigger delay) exceeds the trigger period

29) This function can be used to counteract interactions between the signal source and the input of the power sensor (input of a component ahead of the power sensor if s-parameter correction is activated). By using this function, the nominal power of the source into 50 Ω can be measured (without this correction: power of the incident wave).

30) Expanded uncertainty (k = 2) for absolute power measurements on CW signals at calibration levels (–20 dBm for path 1, 0 dBm for paths 2 and 3) and the calibration frequencies (10 MHz, 15 MHz, 20 MHz, 30 MHz, 50 MHz, 100 MHz; from 250 MHz to 8 (18) GHz in increments of 250 MHz). Specifications include zero offset and display noise (up to a 2 σ value of 0.004 dB)

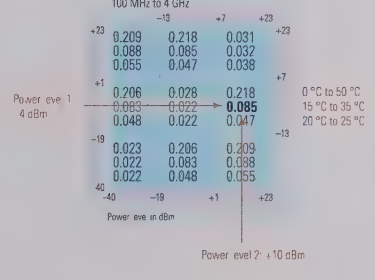
31) Expanded uncertainty (k = 2) for absolute power measurements on CW signals with automatic path selection. Specifications include display noise with a 2 σ value up to 0.01 dB and zero offset for levels from –40 dBm to +23 dBm. Higher display noise and the effect of zero offset at lower levels must be considered separately.
Example: Power to be measured is 3.2 nW (–55 dBm) at 1.9 GHz; ambient temperature is 29 °C; automatic path selection is set. Typical absolute uncertainty due to zero offset equals 64 pW, corresponding to a relative measurement uncertainty of .

$$10 \times \lg\left(\frac{3.2\ \text{nW} + 64\ \text{pW}}{3.2\ \text{nW}}\right) \quad 0.086\ \text{dB}$$

Combined with the specified value of 0.081 dB for the uncertainty of absolute power measurements, the total uncertainty is $\sqrt{0.086^2+0.081^2}$ dB = 0.12 dB. Noise content exceeding 0.01 dB should be considered in the same way.

32) Expanded uncertainty (k = 2) for relative power measurements on CW signals with automatic path selection. Specifications include display noise with a 2 σ value up to 0.01 dB for both the measurement and the reference level as well as zero offsets for all levels from –40 dBm to +23 dBm. Below –40 dBm, the effect of increased relative zero offset must be taken into account (only for the lower level, if both levels are below –40 dBm). Display noise exceeding 0.01 dB must be considered separately for both the measurement level and the reference level (if applicable). See example in footnote [31] for calculation of total uncertainty.

33) Reading the measurement uncertainty for relative power measurements
The example shows a level step of approx. 14 dB (–4 dBm → +10 dBm) at 1.9 GHz and an ambient temperature of 28 °C.



34) Quotient of a measured and a stored reference power ratio, e.g. for measuring gain compression of amplifiers.

35) The operating temperature range defines the span of ambient temperature in which the instrument complies with specifications. In the permissible temperature range, the instrument is still functioning but adherence to specifications is not warranted.

Ordering information

Description	Type	Order No.
Basic Unit		
Power Meter	R&S NRP	1143.8500.02
Power Sensors		
200 pW to 200 mW, 10 MHz to 8 GHz	R&S NRP-Z11	1138.3004.02
200 pW to 200 mW, 10 MHz to 18 GHz	R&S NRP-Z21	1137.6000.02
Options		
Sensor Check Source	R&S NRP-B1	1146.9008.02
Second Sensor Input (B)	R&S NRP-B2	1146.8801.02
3rd and 4th Sensor Inputs (C, D)[1]	R&S NRP-B5	1146.9608.02
Rear-Panel Sensor Inputs A and B[2]	R&S NRP-B6	1146.9908.02
Battery Supply	R&S NRP-B3	1146.8501.02
Recommended extras		
Sensor Extension Cable to 5 m	R&S NRP-Z2	1146.6750.05
Sensor Extension Cable to 10 m	R&S NRP-Z2	1146.6750.10
USB Adapter (active)	R&S NRP-Z3	1146.7005.02
USB Adapter (passive)	R&S NRP-Z4	1146.8001.02
19" Rack Adapter (R&S NRP + dummy)	R&S ZZA-T26	1109.4387.00
19" Rack Adapter (two R&S NRPs)	R&S ZZA-T27	1109.4393.00

[1] Option R&S NRP-B2 required.
[2] Not in conjunction with the R&S NRP-B5.

Certified Environmental System ISO 14001 REG. NO 1954

Certified Quality System ISO 9001 DQS REG. NO 1954

ROHDE&SCHWARZ

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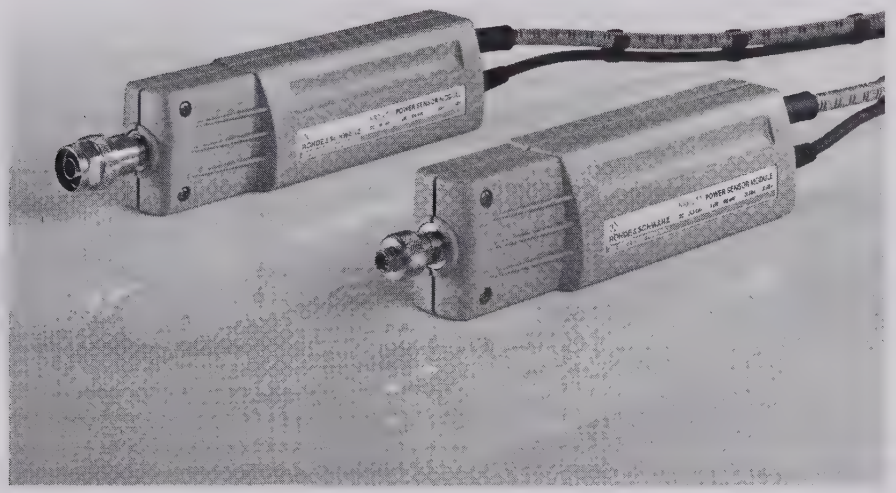
Technical Information



Power Sensor Modules R&S NRP-Z27, -Z37

For accurate absolute power measurements with the R&S FSMR

The new power sensor modules for the frequency ranges DC to 18 GHz (R&S NRP-Z27) and DC to 26.5 GHz (R&S NRP-Z37) turn the R&S FSMR measuring receivers into precision power meters with a dynamic range as large as -115 dBm to +30 dBm. The sensor modules feature not only all the advantages of the thermal measuring principle, but also reliable and repeatable operation due to the use of a power splitter for signal separation.

Excellent isolation from the receiver input is achieved by means of hardware and by numeric precorrection of the splitter, which yields high total accuracy.

Like all other power sensors of the R&S NRP family, the sensor modules are fully self-contained power meters that are remote-controlled from the R&S FSMR, R&S NRP or any Windows PC via USB.

ROHDE&SCHWARZ

Preliminary

Power Sensor Modules R&S NRP-Z27, -Z37

Specifications

Bold: Parameter 100% tested.
Italics: Uncertainties calculated from the test assembly specifications and modeled behavior of the sensor.
Normal: Compliance with specifications is ensured by the design or derived from the measurement of related parameters.

Module type		thermoelectric power sensor with RF signal output
Measurand		average power of incident wave
Frequency range		DC to 18 GHz (R&S NRP-Z27) DC to 26.5 GHz (R&S NRP-Z37)
Matching (SWR)	input DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz RF signal output DC to 8.0 GHz > 8.0 GHz to 26.5 GHz	R&S NRP-Z27 / R&S NRP-Z37 **< 1.15** / **< 1.15** **< 1.18** / **< 1.18** **< 1.23** / **< 1.23** **< 1.25** / **< 1.25** **< 1.35** / **< 1.30** – / **< 1.45** **< 1.6** / **< 1.6** **< 2.0** / **< 2.0**
Power measurement range		4 µW to 400 mW (-24 dBm to +26 dBm) cont., without subranges
Max. power	average pulse energy	0.5 W (+27 dBm) continuous 1.0 W (+30 dBm) for max. 10 minutes 30 Wµs
Display noise [14)]		< 240 nW (typ. 120 nW)
Zero offset [17)]		< 400 nW (typ. 200 nW)
Zero drift [18)]		< 160 nW
Linearity uncertainty [36)]	input power < 0.1 W > 0.1 W	< 0.02 dB < 0.03 dB
Temperature effect [37)]	DC to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	< 0.004 dB/K (typ. 0.0014 dB/K) < 0.005 dB/K (typ. 0.0015 dB/K) < 0.005 dB/K (typ. 0.0017 dB/K) < 0.006 dB/K (typ. 0.0019 dB/K) < 0.009 dB/K (typ. 0.0027 dB/K)
Isolation [38)]	DC to 2.0 GHz > 2.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz	> **23** (51) dB > **25** (37) dB > **26** (35) dB > **26** (32) dB
Insertion loss between input and RF signal output	DC to 2.0 GHz > 2.0 GHz to 4.2 GHz > 4.2 GHz to 8.0 GHz > 8.0 GHz to 12.4 GHz > 12.4 GHz to 18.0 GHz > 18.0 GHz to 26.5 GHz power coefficient	< **14** dB (typ. 12.5 dB) < **15** dB (typ. 13.5 dB) < **16** dB (typ. 14.0 dB) < **17** dB (typ. 14.5 dB) < **18** dB (typ. 15.5 dB) < **19** dB (typ. 16.5 dB) ± (0.02 + 0.002 *f* / GHz)) dB/W
RF connectors	input RF signal output	N (male) for R&S NRP-Z27 3.5 mm (male) for R&S NRP-Z37 3.5 mm (male)

Calibration uncertainty [39]	DC to < 100 MHz	*0.063 dB*		
	100 MHz to 4.2 GHz	*0.070 dB*		
	> 4.2 GHz to 8.0 GHz	*0.082 dB*		
	> 8.0 GHz to 12.4 GHz	*0.088 dB*		
	> 12.4 GHz to 18.0 GHz	*0.109 dB*		
	> 18.0 GHz to 26.5 GHz	*0.118 dB*		
Uncertainty for absolute power measurements with matched load (SWR < 1.05) [40] From -10 dBm to +26 dBm		20°C to 25°C	15°C to 35°C	0°C to 50°C
	DC to < 100 MHz	*0.070 dB*	*0.077 dB*	*0.103 dB*
	100 MHz to 4.2 GHz	*0.075 dB*	*0.082 dB*	*0.106 dB*
	> 4.2 GHz to 8.0 GHz	*0.087 dB*	*0.094 dB*	*0.119 dB*
	> 8.0 GHz to 12.4 GHz	*0.093 dB*	*0.101 dB*	*0.130 dB*
	> 12.4 GHz to 18.0 GHz	*0.112 dB*	*0.121 dB*	*0.151 dB*
	> 18.0 GHz to 26.5 GHz	*0.122 dB*	*0.137 dB*	*0.190 dB*
Uncertainty for absolute power measurements on R&S FSMR26 [40] From -10 dBm to +26 dBm		20°C to 25°C	15°C to 35°C	0°C to 50°C
	DC to < 100 MHz	*0.104 dB*	*0.109 dB*	*0.128 dB*
	100 MHz to 4.2 GHz	*0.116 dB*	*0.120 dB*	*0.138 dB*
	> 4.2 GHz to 8.0 GHz	*0.163 dB*	*0.166 dB*	*0.181 dB*
	> 8.0 GHz to 18.0 GHz	*0.183 dB*	*0.187 dB*	*0.207 dB*
	> 18.0 GHz to 26.5 GHz	*0.226 dB*	*0.235 dB*	*0.269 dB*
After numerical isolation correction	DC to < 100 MHz	*0.067 dB*	*0.074 dB*	*0.101 dB*
	100 MHz to 4.2 GHz	*0.077 dB*	*0.083 dB*	*0.107 dB*
	> 4.2 GHz to 8.0 GHz	*0.092 dB*	*0.099 dB*	*0.123 dB*
	> 8.0 GHz to 12.4 GHz	*0.099 dB*	*0.107 dB*	*0.135 dB*
	> 12.4 GHz to 18.0 GHz	*0.122 dB*	*0.130 dB*	*0.159 dB*
	> 18.0 GHz to 26.5 GHz	*0.154 dB*	*0.167 dB*	*0.212 dB*
Measurement window [7]	duration	2 × (1 ms to 300 ms)		
	shape	rectangular (integrating behavior) Von Hann (smoothing filter, for efficient suppression of result variations due to modulation [26])		
Measurement time [27]		N×(duration of measurement window + 0.5 ms)+t_z t_z : < 82 ms		
Zeroing (duration)	depends on averaging filter			
	AUTO ON	4 s		
	AUTO OFF			
	Integration time [16] < 4 s	4 s		
	4 s...16 s	integration time [16]		
	> 16 s	16 s		
Averaging filter	modes	AUTO OFF (fixed averaging factor) AUTO ON (continuously auto-adapted) AUTO ONCE (automatically fixed once)		
	normal operating mode [23]	setting of filter depends on power to be measured and resolution		
	resolution	1 (1 dB), 2 (0.1 dB), 3 (0.01 dB), 4 (0.001 dB)		
	fixed noise operating mode	filter set to specified noise content		
	noise content	0.0001 dB to 1 dB		
	max. measurement time [24]	0.01 s to 1000 s		
	averaging factor N	1 to 2^{16} (number of averaged measurement windows)		
	result output			
	moving average	continuous with every newly evaluated measurement window (e.g. in case of manual operation via R&S NRP)		
	repeat	only final result (e.g. in case of remote control of R&S NRP)		

Duty cycle correction [8)]		0.001 % to 99.999 %
Attenuation correction	function range	correcting the measurement result by means of a fixed factor (dB offset) -100.000 dB to +100.000 dB
Γ correction	function parameters	reducing the influence of mismatched sources [29)] magnitude and phase of reflection coefficient of source
Frequency response correction	function parameter	taking into account the calibration factors relevant for the test frequency carrier frequency (center frequency)
Isolation correction	function parameter	taking into account the reflection coefficient of the load on the RF signal output magnitude and phase of reflection coefficient of the load
Interface to host	power supply remote control trigger input	typ. +5 V / 100 mA (USB low-power device) as a USB device (function) in full-speed mode, compatible with USB 1.0/1.1/2.0 specifications differential (0 / +3.3 V)
Dimensions (W × H × L)		48 mm × 50 mm × 250 mm length incl. connecting cable: approx. 1.75 m
Weight		< 0.7 kg

1)

... See the R&S NRP data sheet (PD 0757.7023.21).

35)

36) For relative measurements referenced to 0 dBm.

37) Taking into consideration change of sensitivity for power sensor, drift of insertion loss for power splitter and phase change of RF cable (with the R&S FSMR26 connected to the RF signal output).

38) Between RF signal output and input of the integrated power sensor. It can be expressed by $20\,dB\log|s_{21}/(s_{23}\cdot s_{31})|$, where s_{xy} are S parameters of the power splitter (including cable). Port 1 denotes the input of the power sensor module, port 2 the input of the internal power sensor and port 3 the RF signal output. The power measurement error introduced due to mismatch of an R&S FSMR26 does not exceed 0.06 dB from DC to 2 GHz, 0.10 dB up to 18 GHz, and 0.14 dB up to 26.5 GHz.

Values in parentheses represent effective isolation, which can be achieved after numerical isolation correction of the measurement result inside the sensor. Isolation correction requires the complex reflection coefficient of the load on the RF signal output to be sent to the sensor. Residual power measurement error introduced by an R&S FSMR26 after isolation correction does not exceed 0.01 dB from DC to 2 GHz, 0.025 dB up to 8 GHz, 0.04 dB up to 18 GHz, and 0.07 dB up to 26.5 GHz.

39) Expanded uncertainty (k=2) for absolute power measurements at the calibration level (0 dBm) and the calibration frequencies at 20°C to 25°C. Specifications include zero offset and display noise (up to a 2 σ value of 0.01 dB). The load on the RF signal output must be a low-reflection type (SWR < 1.05) or isolated by numerical correction (see footnote 38).

Calibration frequencies: 0.1/0.5/1/3/5/10/50/100 MHz; from 100 MHz to the upper frequency limit in increments of 100 MHz.

40) At calibration frequencies. Includes the effects of calibration uncertainty, linearity, zero offset and drift, temperature, display noise (up to a value of 0.01 dB) and mismatch of the load on the RF signal output. For power levels below -10 dBm, the effect of zero offset must be calculated separately.

General specifications

See the R&S NRP data sheet (PD 0757.7023.21), Sensors R&S NRP-Z11/-Z21.

Accessories

See the R&S NRP data sheet (PD 0757.7023.21)

Ordering information

Description	Type	Order No.
Power Sensor Module 4 µW to 400 mW; DC to 18 GHz	R&S NRP-Z27	1169.4102.02
Power Sensor Module 4 µW to 400 mW; DC to 26.5 GHz	R&S NRP-Z37	1169.3206.02

ROHDE & SCHWARZ

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Before putting the product into operation for the first time, make sure to read the following

Safety Instructions

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that the product be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

Observe product documentation	Weight indication for units >18 kg	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Attention! Electrostatic sensitive devices

Supply voltage ON/OFF	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double/reinforced insulation

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	This tag indicates a definite hazard carrying a high risk of death or serious injury if not avoided.
WARNING	This tag indicates a possible hazard carrying a medium risk of death or (serious) injury if not avoided.
CAUTION	This tag indicates a hazard carrying a low risk of minor or moderate injury if not avoided.
ATTENTION	This tag indicates the possibility of incorrect use that can cause damage to the product.
NOTE	This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material damage.

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products:
   prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

4. If products/components are mechanically and/or thermically processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.
20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.
23. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
    If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.
33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.

Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes

Informaciones de seguridad

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estandards de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los estandards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la industria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos parciales del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso del producto a personas peritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

Ver documentación de producto	Informaciones para maquinaria con uns peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electroestática

potencia EN MARCHA/PARADA	Indicación Stand-by	Corriente continua DC	Corriente alterna AC	Corriente continua/alterna DC/AC	El aparato está protegido en su totalidad por un aislamiento de doble refuerzo

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas Rohde & Schwarz bajo la denominación de „producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
CUIDADO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
INFORMACIÓN	Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación de producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a malinterpretaciones y tener por consecuencia daños en personas u objetos.

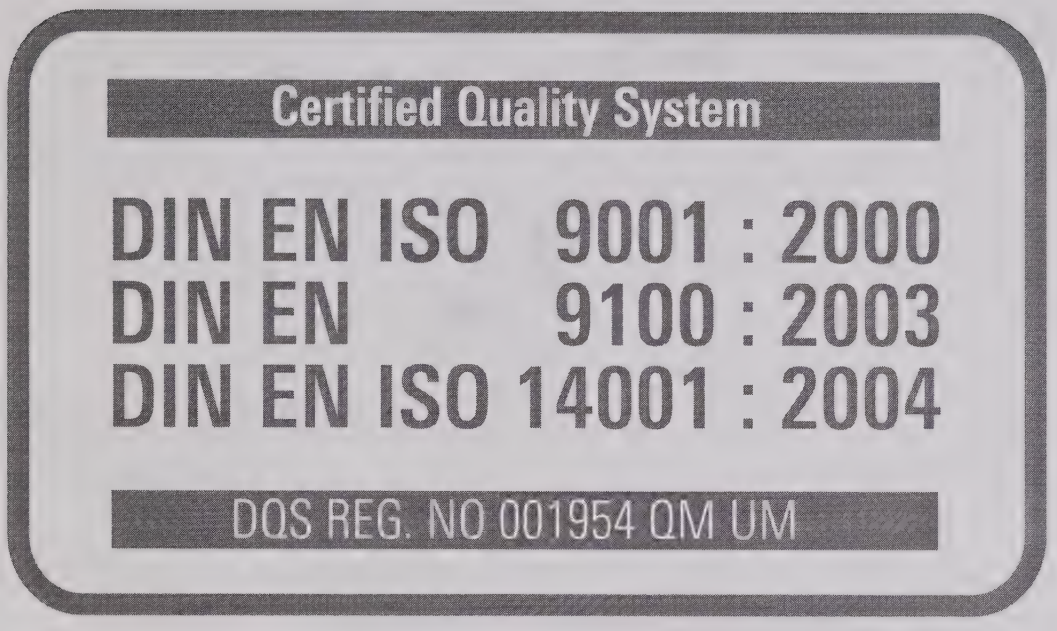
Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
   como posición de funcionamiento se define principialmente la posición con el suelo de la caja para abajo , modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar.
   A menos que se especifique otra cosa en la hoja de datos, se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.
2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal perito autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se producieran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averigurar los motivos de estas reacciones.
4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberan ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.
6. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario/usario está comprometido a valorar y señalar areas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del prodcuto.
9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.
11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
16. En las mediciones en circuitos de corriente con una tensión de entrada de U_{eff} > 30 V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.
18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
23. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención celulas de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.
29. El producto puede poseer un peso elevado. Muévalo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean tenidas en cuenta. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.



QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.
Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICATE OF QUALITY

Dear Customer,
you have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

CERTIFICAT DE QUALITÉ

Cher Client,
vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:2004

ROHDE&SCHWARZ

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ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 2002-36, page 1

This is to certify that:

Equipment type	Stock No.	Designation
NRP	1143.8500.02	Power Meter
NRP-B1	1146.9008.02	Sensor Check Source
NRP-B2	1146.8801.02	Second Sensor Input
NRP-B3	1146.8501.02	Battery Supply
NRP-B4	1146.9308.02	Ethernet Lan-Interface
NRP-B5	1146.9608.02	3rd und 4th Sensor
NRP-B6	1146.9908.02	Rear-Panel Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
EN55011 : 1998 + A1 : 1999
EN61326 : 1997 + A1 : 1998 + A2 : 2001

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2002

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2005-10-28

Central Quality Management FS-QZ / Radde

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 2002-36, page 2

This is to certify that:

Equipment type	Stock No.	Designation
NRP-Z3	1146.7005.02	USB Adapter
NRP-Z4	1146.8001.02/.04	USB Adapter
NRP-Z11	1138.3004.02/.04	Average Power Sensor
NRP-Z21	1137.6000.02	Average Power Sensor
NRP-Z22	1137.7506.02	Average Power Sensor
NRP-Z23	1137.8002.02	Average Power Sensor
NRP-Z24	1137.8502.02	Average Power Sensor
NRP-Z27	1169.4102.02	Power Sensor Module
NRP-Z37	1169.3206.02	Power Sensor Module
NRP-Z51	1138.0005.02	Thermal Power Sensor
NRP-Z55	1138.2008.02	Thermal Power Sensor
NRP-Z91	1168.8004.02/.04	Average Power Sensor

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

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ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2005-10-28

Central Quality Management FS-QZ / Radde

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Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

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Feedback

We want to know if we are meeting your support needs. If you have any comments please email us and let us know CustomerSupport.Feedback@rohde-schwarz.com.

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Fax	+1 410 910 7801
E-mail	Customer.Support@rsa.rohde-schwarz.com

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1171.0200.22-01.00

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1 Putting into Operation

Follow the instructions below precisely to prevent damage to the sensor – particularly when you are putting the power sensor module into operation for the first time.

Unpacking the sensor

Remove the power sensor module from its packing and check that nothing is missing. Inspect all items for damage. If you discover any damage, inform the carrier responsible immediately and keep the packing to support any claims for compensation.

It is also best to use the original packing if the power sensor module is to be shipped or transported at a later date.

The power sensor module contains components which can be destroyed by electrostatic discharges. To prevent this happening, never touch the inner conductor of the RF connector and never open the power sensor module.

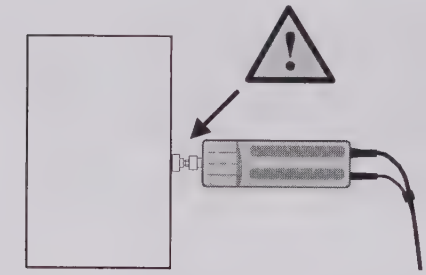
Connecting the sensor

To prevent EMI, the power sensor module must never be operated with its enclosure wholly or partially removed. Only use shielded cables that meet the relevant EMC standards.

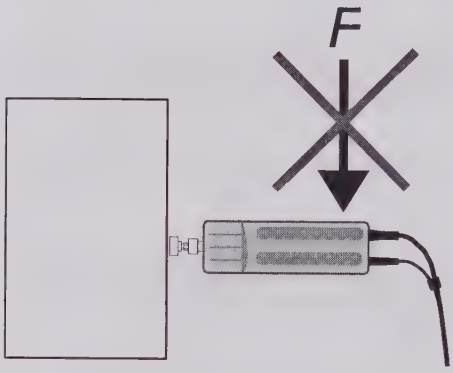
Never exceed the maximum RF power limit. Even brief overloads can destroy the integrated power sensor.

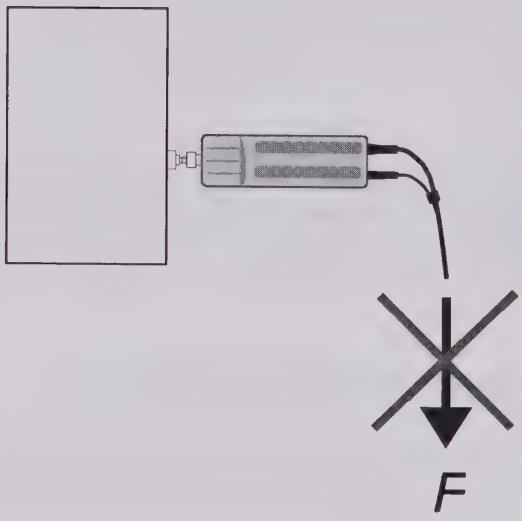
To prevent erroneous measurements, always terminate the RF output of the power sensor module (at the cable end) with a matched load or matched measuring instrument input.

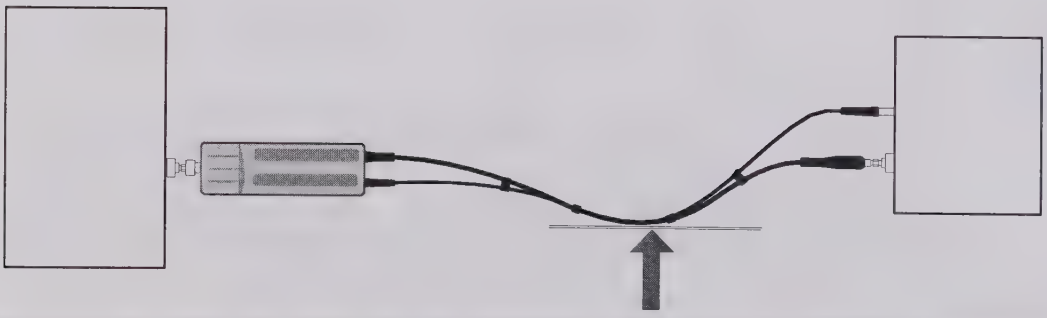
In many cases, the RF connector only requires manual tightening. However, for maximal measurement accuracy, the RF connector must be tightened using a torque wrench with a nominal torque of 1.36 Nm (12" lbs.) for the N connector of the R&S NRP-Z27, or 0.9 Nm (8" lbs.) for the 3.5 mm connector of both power sensor modules.



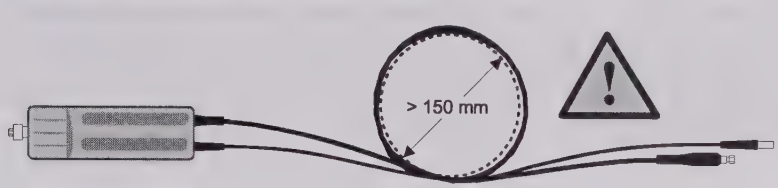
Do not apply excessive mechanical force to the RF connectors of the R&S NRP-Z27/-Z37 and DUT!



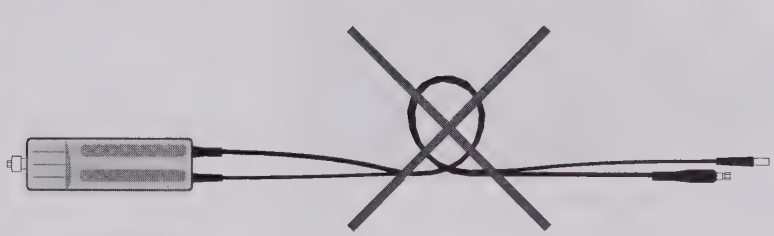




Make sure the bending radius of the RF connecting cable is at least 75 mm!



A tighter bend can permanently impair the measuring accuracy of the power measurement module!



Operation with the Measuring Receiver R&S FSMR

Connecting the power sensor module to the R&S FSMR

The power sensor module can be connected to the Measuring Receiver R&S FSMR when it is in operation. The multiple circular plug-in connector must be inserted, red marking upwards, into the *POWER SENSOR* connector. Then connect the 3.5 mm male connector of the RF cable with measurement input *RF INPUT 50 Ω*. If you are using model R&S FSMR26 or R&S FSMR50, you must first install the appropriate test port adapter with 3.5 mm female connector (R&S 1021.0512.00). With model R&S FSMR3, which has a built-in N-connector, screw on the adapter with the 3.5 mm female connector and male N connector that is supplied. Only the use of these adapters ensures correct functioning of the *VSWR Correction* function on the R&S FSMR.

Connecting the power sensor module to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

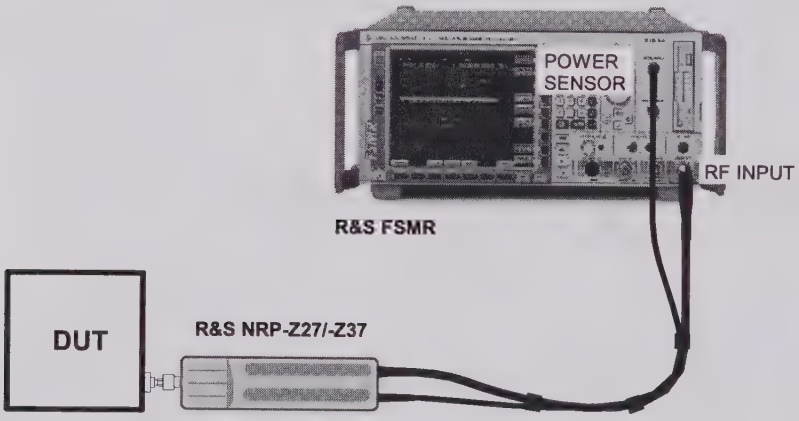


Fig. 1-1 Configuration with the R&S FSMR

Performing measurements

The R&S FSMR handles the power sensors modules in a manner similar to the sensors of the R&S NRP-Z series. To call up the power meter functionality, first press the PRESET key and then the PWR METER softkey. For further details on operation, refer to the operating manual for the R&S FSMR.

Operation with the Power Meter R&S NRP

Connecting the power sensor module

The power sensor module can be connected to the R&S NRP base unit when it is in operation. The multiple circular plug-in connector must be inserted, red marking upwards, into one of the R&S NRP base unit's sensor connectors. When the power sensor module is connected, it is detected by the R&S NRP base unit and initialized.

Terminate the output of the RF cable with a 3.5 mm precision termination (with female connector input). The exact matching value is insignificant as long as the standing wave ratio of the measurement frequency remains smaller than 1.05. Otherwise, you have to check whether the increased measurement uncertainty can be accepted (see the *Isolation* parameter in the specifications as well as *SENse:RGAMma* group of commands in chapter 6).

Connecting the power sensor module to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

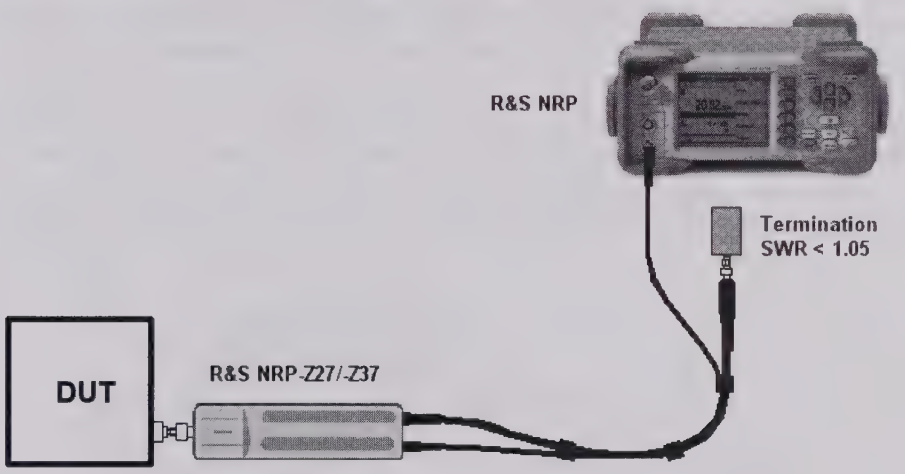


Fig. 1-2 Configuration with the R&S NRP

Performing measurements

The R&S NRP handles the power sensor modules in the same manner as the thermal power sensors of the R&S NRP-Z5x series. An exception is the S-parameter correction function, which is always activated in the power sensor modules. This function takes the integrated power splitter into consideration. Therefore, the influence of adapters or attenuators which are connected ahead of the input of the power sensor module cannot be compensated via the S-parameter correction function. However, compensation by using a global offset or an offset table is always possible.

PC control

Hardware and software requirements

The following requirements must be met if the sensor is to be controlled by a PC via an interface adapter:

- The PC must have a USB port.
- The PC's operating system must support the USB port. This is the case with Windows™ 98, Windows™ ME, Windows™ 2000, Windows™ XP and more recent versions of the Windows™ operating system.
- The USB device drivers in the supplied *NRP Toolkit* software package must be installed.

If these requirements are met, the sensor can be controlled using a suitable application program such as the NrpFlashup program contained in the NRP Toolkit (includes the modules Power Viewer, USB Terminal, Firmware Update and Update S-Parameters).

When you insert the CD-ROM supplied with the R&S NRP, the NRP Toolkit is automatically installed on your PC. The rest of the procedure is self-explanatory.

The sensor can be powered in two ways:

- *Self-powered* from a separate power supply via the Active USB Adapter R&S NRP-Z3.
- *Bus-powered* from the PC or a USB hub with its own power supply (*self-powered hub*) via the Active USB Adapter R&S NRP-Z3 or via the Passive USB Adapter R&S NRP-Z4.

Because the sensor R&S NRP-Z5x has a maximum current capacity of 100 mA and is therefore classified as a low-power device, it can be supplied with current from any stationary PC, laptop or notebook in the bus-powered mode.

Operation via the Active USB Adapter R&S NRP-Z3

Fig. 1-3 shows the configuration with the Active USB Adapter R&S NRP-Z3, which also makes it possible to feed in a trigger signal for the *Timeslot* and *Scope* modes. The order in which the cables are connected is not critical.

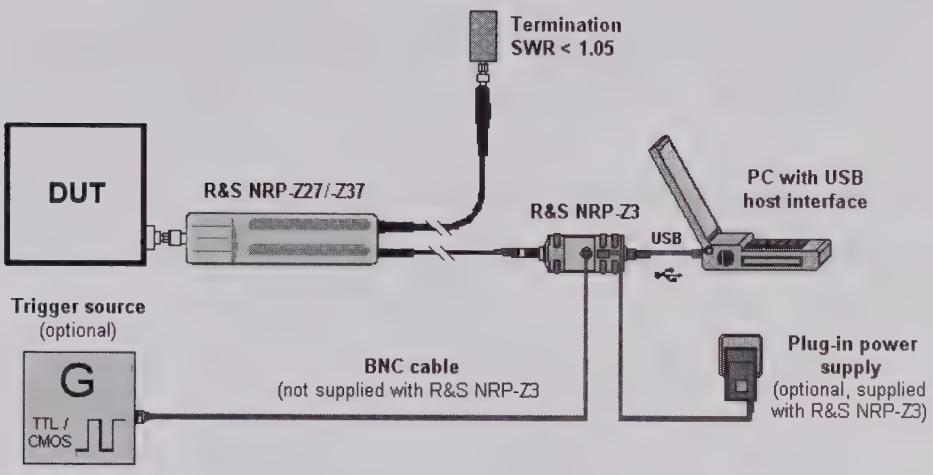


Fig. 1-3 Configuration with Active USB Adapter R&S NRP-Z3

The plug-in power supply for the R&S NRP-Z3 can be powered from a single-phase AC source with a nominal voltage range of 100 V to 240 V and a nominal frequency between 50 Hz and 60 Hz. The plug-in power supply autosets to the applied AC voltage. No manual voltage selection is required.

The plug-in power supply comes with four primary adapters for Europe, the UK, the USA and Australia. No tools of any kind are required to change the primary adapter. The adapter is pulled out manually and another adapter inserted until it locks (Fig. 1-4).

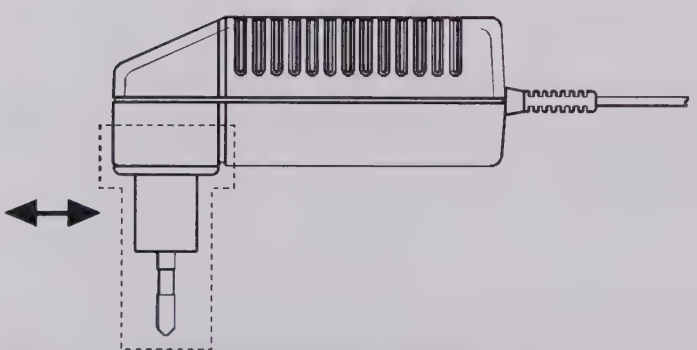


Fig. 1-4 Changing the primary adapter

The plug-in power supply is short-circuit-proof and has an internal fuse. It is not possible to replace this fuse or open the plug-in power supply.

The plug-in power supply is not intended for outdoor use.

Keep within the temperature range of 0°C to 50°C.

If there is any condensation on the plug-in power supply, dry it off before connecting it to the AC supply.

Operation via the Passive USB Adapter R&S NRP-Z4

Fig. 1-5 is a schematic of the measurement setup. The order in which the cables are connected is not critical.

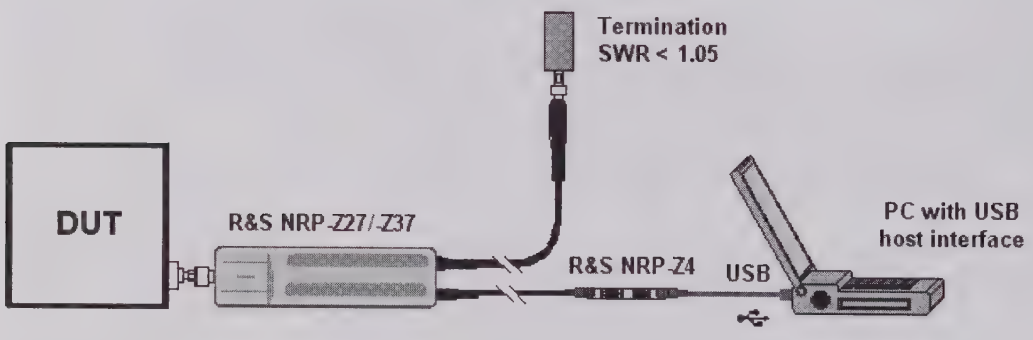


Fig. 1-5 Configuration with Passive USB Adapter R&S NRP-Z4

Connecting the sensor to the DUT

The power sensor modules have a male N connector (R&S NRP-Z27) or a male 3.5 mm connector (R&S NRP-Z37) on their RF input and can thus be connected to any standard female N or 2.92 mm/3.5 mm/SMA connector, respectively. To connect the power sensor module to the DUT more easily and without tilting it, relieve it by slightly lifting it.

Performing measurements

The R&S NRP uses the power sensor modules in the same manner as the thermal power sensors of the R&S NRP-Z5x series. An exception is the S-parameter correction function, which is always activated in the power sensor modules. This function takes the integrated power splitter into consideration. Therefore, the influence of adapters or attenuators which are connected ahead of the input of the power sensor module cannot be compensated via the S-parameter correction function. However, compensation by using a global offset or an offset table is always possible.

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2 Virtual Power Meter

You will find the **NrpFlashup** program that enables you to operate the power sensor module with a PC under Windows™ on the CD-ROM that accompanies the power sensor module. The program comprises several modules which can be started centrally via the Windows™ start-menu entry **NRP Toolkit**.

This section describes the **Power Viewer** program module. This is a virtual power meter which only uses a cut-down set of the sensor's functions. This means that after an extremely brief familiarization period, you can perform measurements.

The other modules in **NrpFlashup** are described in Chapter 3 of the operating manual (**Terminal** module) or in the service manual (**Firmware Update** module).

Overview

Start the virtual power meter using the **NRP Toolkit** – **Power Viewer** start-menu entry. The **Power Viewer** program window is displayed (Fig. 2-1).

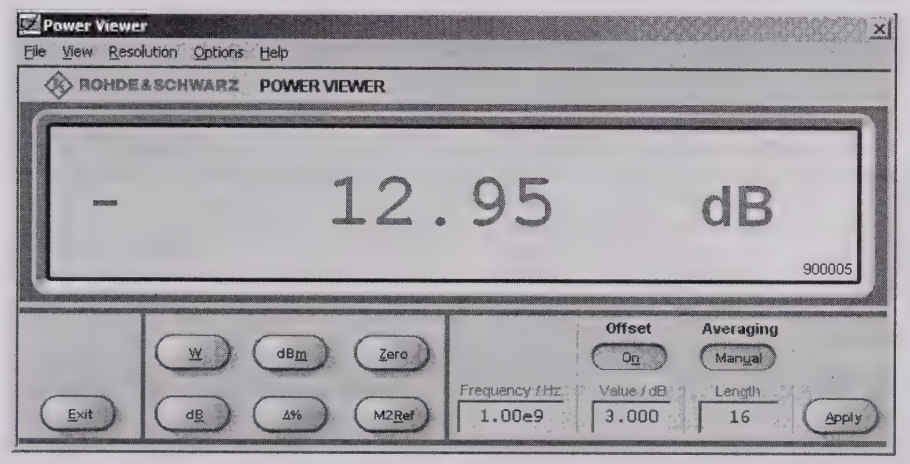


Fig. 2-1 **Power Viewer** – virtual power meter

The result display occupies most of the program window. The result, unit and additional power sensor module status information are displayed. The serial number of the sensor is displayed in the bottom right. The program window also contains animated buttons and entry fields (see Table 2-1 and Table 2-2).

Table 2-1 Virtual power meter keys

Button	Function	Key combination
Exit	Terminates the program. The current settings are saved and recalled the next time the program is started.	Alt + E
W	Selects Watt as the display unit.	Alt + W
dBm	Selects dBm as the display unit.	Alt + M
Zero	Zeroes the power sensor module.	Alt + Z
dB	Selects dB as the display unit. This is the log of the ratio of the measured value to the reference value.	Alt + B
Δ%	Selects % as the display unit. The difference between the measured value and the reference value is expressed as a percentage.	Alt + %
M2Ref	Makes the current measured value the reference value for the relative display units dB and %.	Alt + R
Offset On/Off	Turns the global offset correction for the power sensor module on or off. If the offset correction is Off, the **Offset/dB** entry field has a grey background.	Alt + N
Averaging Man/Auto	Turns auto-averaging on or off. When auto-averaging is on, the **Length** entry field has a grey background; the current averaging factor is displayed.	Alt + T
Apply	Accepts edited numerical values in the **Frequency/Hz**, **Value/dB** and **Length** entry fields and transfers them to the sensor.	Alt + A or Enter key

Table 2-2 Virtual power meter entry fields

Entry field	Function
Frequency/Hz	Frequency of the RF carrier in Hertz.
Value/dB	Attenuation in dB of the component connected to the power sensor module. The valid range is –100 to 100. The offset correction must be activated beforehand with the **Offset On/Off** button if this entry field is to be edited.
Length	Length of the averaging filter (= averaging factor). The valid range is 1 to 65536. Averaging must be set to manual with the **Averaging Man/Auto** button if this entry field is to be edited.

Scientific notation can also be used for the entry fields. If an invalid entry is made, an error message is output. An edited numerical value will not be transferred to the power sensor module unless you use the **Apply** button or the Enter key to terminate the entry.

Menus

The menu bar can be used to call less frequently used functions.

File

Start Log ...

Opens a file-selection dialog to specify the path and name of the log file. Clicking the **Save** button starts the recording. All displayed values are written line-by-line to the log file with the date (format: YY/MM/DD) and time (format: hh:mm:ss.ms). Example:

```
-22.51 dBm (03/02/25 15:37:25.310)
```

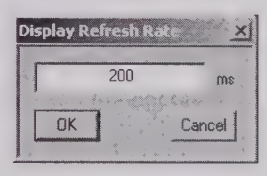
Stop Log

Ends the log-file recording.

View

Display Refresh Rate

Opens a dialog box to adjust the display refresh rate. The time in milliseconds between two refresh operations is entered. The default setting is 200 ms.



Colours

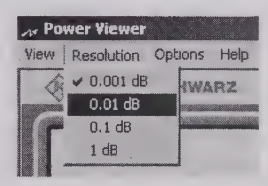
Opens a dialog box to select the background colour for

- the result,
- the unit,
- the text in the number fields or
- the key labelling.

Result
Unit
Edit
Button

Resolution

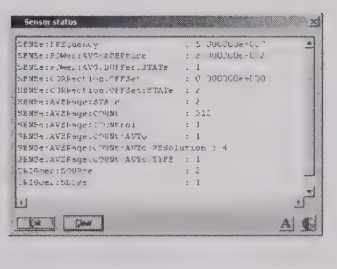
For setting the result resolution. If auto-averaging has been selected, a higher resolution leads to a greater averaging factor, which means a longer result settling time.



Options

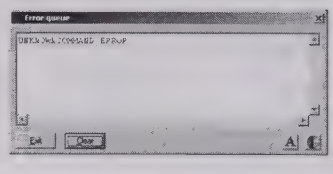
Read Sensor Status ...

Reads the current status of the power sensor module. A parameter list is output.



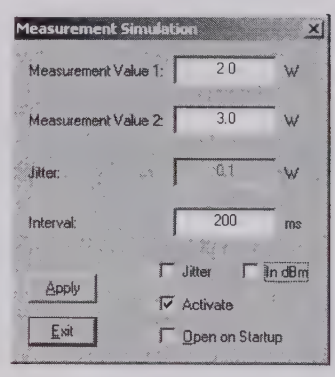
Read Error Queue ...

Reads the error queue. All the error messages that have been issued since the last call are read line-by-line. A tick before this menu entry indicates that an error has occurred.



Simulation ...

Allows you to try out the functions of the virtual power meter even without a power sensor module. The display alternates between **Measurement Value 1** & **Measurement Value 2** with a period given by **Interval**. Simulation can be activated immediately with the **Activate** check box.



Reset Sensor

Initializes the power sensor module. Any previous zeroing remains valid.

Help

Contents

Opens the table of contents for the online-help facility.

About

Displays information about the program version used, etc.

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3 Manual Operation

The previous section describes the Power Viewer program module supplied with the instrument. This module simplifies the most frequently used function of a power meter – measuring the average power of an RF signal. Other program modules are also part of the supplied equipment and can be selected in the Start menu:

- **Power Viewer**: A detailed description of this virtual power meter module is provided in section 2.
- **Terminal**: Program module for sending commands and command sequences to the power sensor module and for displaying measurement results, status information and other data from the sensor
- **Firmware Update**: Program module for updating the firmware in the power sensor module.
- **Update S-Parameters**: Program module for loading an s-parameter table into the sensor. The power splitter integrated in the power sensor module already occupies this data record. Thus, any adapters or attenuators connected ahead of the power sensor modules cannot be taken into consideration via the S-parameter correction function. Since overwriting the existing data record would result in the loss of the functionality of the power sensor module, *Update S-Parameters* is not further described.

Program module "Terminal"

Main control elements

With the USB terminal, commands and command sequences can be sent to the power sensor module in two different ways:

- Commands are entered in the **Input** field (Fig. 3-1). Consecutive commands can be entered as separate lines, one below the other. The buttons associated with the **Input** field are described in Table 3-1.
- Commands or command sequences are stored in *command files*. Command files are created with a text editor, for instance, and then stored. They can be called as often as required (Fig. 3-2). The buttons of the **Command File** field are described in Table 3-2.

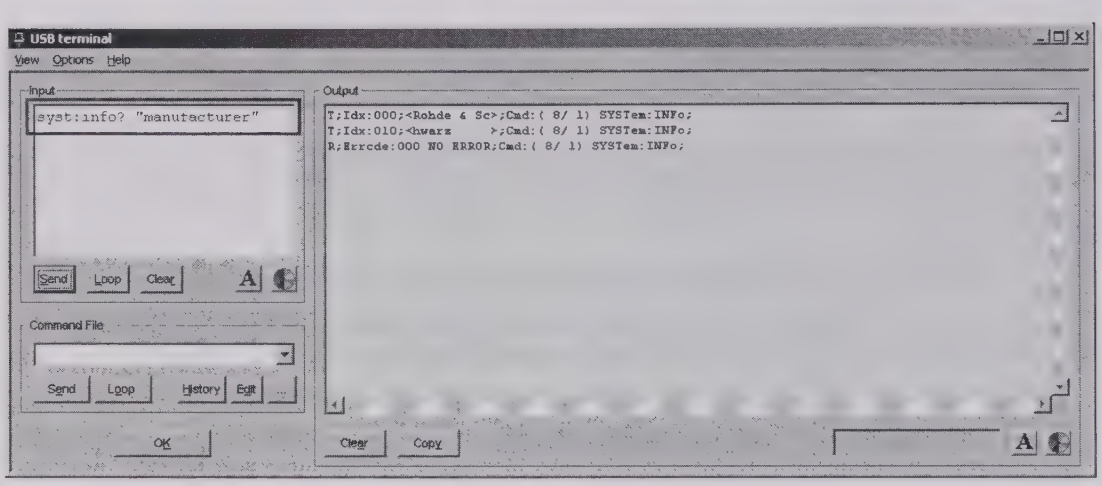


Fig. 3-1 Sending commands using the **Input** field

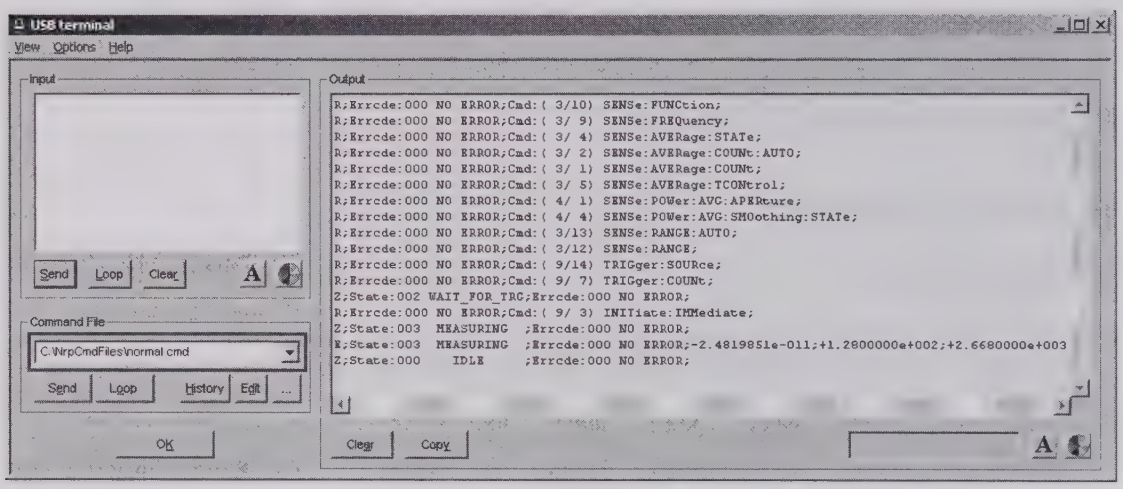

USB terminal
View Options Help
Input
Send Loop Clear
Command File
C:\NrpCmdFiles\normal.cmd
Send Loop History Edit ...
OK
Output
R;Errcde:000 NO ERROR;Cmd:(3/10) SENSe:FUNCtion;
R;Errcde:000 NO ERROR;Cmd:(3/ 9) SENSe:FREQuency;
R;Errcde:000 NO ERROR;Cmd:(3/ 4) SENSe:AVERage:STATe;
R;Errcde:000 NO ERROR;Cmd:(3/ 2) SENSe:AVERage:COUNt:AUTO;
R;Errcde:000 NO ERROR;Cmd:(3/ 1) SENSe:AVERage:COUNt;
R;Errcde:000 NO ERROR;Cmd:(3/ 5) SENSe:AVERage:TCONtrol;
R;Errcde:000 NO ERROR;Cmd:(4/ 1) SENSe:POWer:AVG:APERture;
R;Errcde:000 NO ERROR;Cmd:(4/ 4) SENSe:POWer:AVG:SMOothing:STATe;
R;Errcde:000 NO ERROR;Cmd:(3/13) SENSe:RANGE:AUTO;
R;Errcde:000 NO ERROR;Cmd:(3/12) SENSe:RANGE;
R;Errcde:000 NO ERROR;Cmd:(9/14) TRIGger:SOURce;
R;Errcde:000 NO ERROR;Cmd:(9/ 7) TRIGger:COUNt;
Z;State:002 WAIT_FOR_TRG;Errcde:000 NO ERROR;
R;Errcde:000 NO ERROR;Cmd:(9/ 3) INITiate:IMMediate;
Z;State:003 MEASURING ;Errcde:000 NO ERROR;
E;State:003 MEASURING ;Errcde:000 NO ERROR;-2.48198516-011;+1.2800000e+002;+2.6680000e+003
Z;State:000 IDLE ;Errcde:000 NO ERROR;
Clear Copy

Fig. 3-2 Sending commands using command files

Table 3-1 Buttons assigned to the **Input** field

Button	Function	Key combination
Send	Sends the content of the **Input** entry field to the power sensor module.	Alt + S
Loop	With **Loop** the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with **View - Loop...**	Alt + L
Clear	Clears the content of the **Input** field.	Alt + R
Font key	Opens a dialog window where the font for the **Input** field can be selected.	
Colour key	Opens a dialog window where the background colour of the **Input** field can be selected.	

Table 3-2 Buttons assigned to the **Command File** field

Button	Function	Key combination
Send	Sends the content of the command file to the power sensor module.	Alt + E
Loop	With **Loop** the command or command sequence is cyclically sent. Pressing the button again terminates the cyclic transmission. The repetition rate is set in a dialog window that can be opened with **View - Loop...**	Alt + O
History	Opens a window for editing the command file name in the **Command File** field.	Alt + H
Edit	Opens the selected command file in the Windows™ text editor.	Alt + D
...	Opens a file opening dialog for selecting the command file.	

A command line starting with a tab, a blank or a special character is considered a comment and not forwarded to the power sensor module.

Measurement results, parameters and status information that are returned are displayed in the **Output** field.

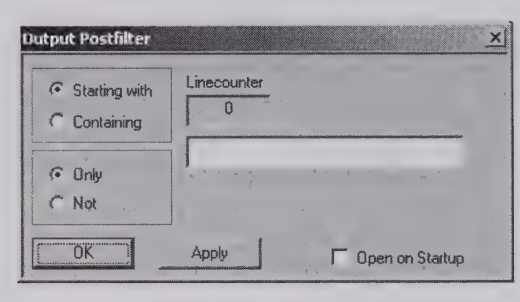
Table 3-3 Buttons assigned to the **Output** field

Button	Function	Key combination
Clear	Clears the content of the **Output** field	Alt + A
Copy	Copies the content of the **Output** field to the clipboard. (Another possiblity: mark the desired information in the output window with the mouse cursor, press the right mouse key or Ctrl+C and then copy the selected text to the clipboard using the menu item **Copy** in the opened context menu.)	Alt + Y
Font button	Opens a dialog window where the font for the **Output** field can be selected.	
Colour button	Opens a dialog window where the background colour of the **Output** field can be selected.	

Close the USB terminal with OK.

Menus

View **Post Filter ...** Opens the **Output Postfilter** dialog window where the lines stored in the input buffer can be filtered according to different criteria.



Filter criteria:

Only + **Starting with**: Only lines starting with the entered character string are displayed.

Not + **Starting with**: Only lines not starting with the entered character string are displayed.

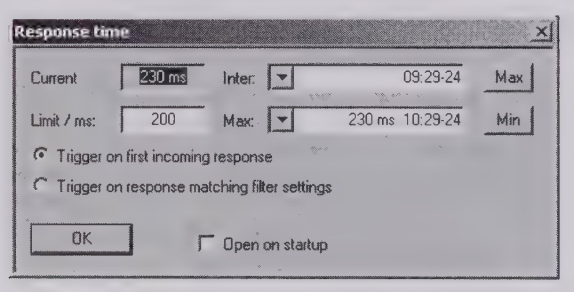
Only + **Containing**: Only lines containing the entered character string are displayed.

Not + **Containing**: Only lines not containing the entered character string are displayed.

Lines not matching the specific filter criterion are blanked but not cleared.
Filtering is started with **Apply**. The number of lines matching the filter criterion is displayed in the **Linecounter** field. If **Open on startup** is active, the **Output Postfilter** dialog is automatically opened when the terminal is started. The dialog window is closed with **OK**.

.

Response Time ... Opens the **Response time** dialog window where the response time of the power sensor module can be set.



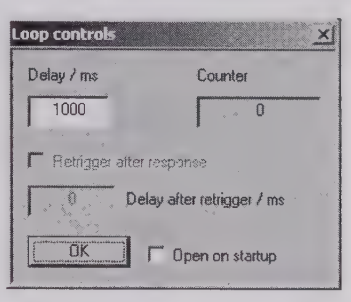
Current indicates the time elapsed between dispatch of the last command and receipt of an acknowledgement from the power sensor module.
When the **Max** button is clicked, the response times exceeding the value in the **limit / ms** field are recorded. When the **Min** button is clicked, the response times within the value in the **limit / ms** field are recorded.

If **Trigger on first incoming response** is active, the time measurement is terminated as soon as the first response arrives after a command is sent. If **Trigger on response matching filter settings** is active, the time measurement is terminated as soon as the first response matching the filter criterion in the **Output Postfilter** dialog window is received.

If **Open on startup** is active, the **Response Time** dialog is automatically displayed when the Terminal module is started. The dialog window is closed with **OK**.

Loop ...

Opens the **Loop controls** dialog window where the cyclic transfer of commands and command sequences can be controlled.



In the **Delay / ms** field, the time interval for the cyclic transfer is specified in milliseconds.

The number of completed transfer cycles is displayed in the **Counter** field. If **Open on startup** is active, the **Response time** dialog is automatically opened when the Terminal module is started. The dialog window is closed with **OK**.

Options

Protocol Mode In this mode, a time stamp is added to each response block.

Hex Mode In this mode, the response blocks from the sensor are displayed in hexadecimal format.

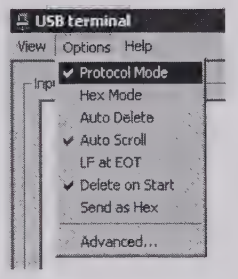
Auto Delete With this option active, the **Output** field is automatically cleared when the **Send** button is pressed.

Auto Scroll With this option active, older items in the **Output** field are automatically shifted upward and off the display if space is required for new values.

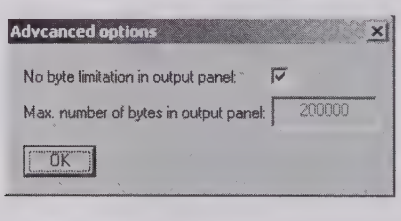
LF at EOT With this option active, a line feed is appended to each response block from the sensor.

Delete on Start With this option active, the **Output** field is automatically cleared when the Terminal module is started.

Send as Hex With this option active, the text in the **Input** field is interpreted as a hexadecimal character sequence.



Advanced ... Opens a dialog window where the buffer size for the **Output** field can be set.



Help

Contents Opens the table of contents for the online help.

About Displays information about the program version, etc.

Program module "Firmware Update"

A detailed description of the program module for firmware updates is provided in the Service Manual.

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5 Remote Control – Fundamentals

Rohde & Schwarz recommends to utilize the VXI Plug & Play Driver for the remote control of R&S NRP power sensors and power sensor modules. This driver can be found on the CD-ROM supplied with the sensor or downloaded in its most recent version via the internet (http://rohde-schwarz.com/).

The old remote control interface provided by the *Dynamic Link Library NrpControl.dll* is not developed further, but remains on the CD-ROM and can be downloaded via the internet.

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SENSe:AVERage:COUNt:AUTO:NSRatio[?] 0.0001 to 1.0 ..... 6.7

SENSe:AVERage:COUNt:AUTO:RESolution[?] 1 to 4 ..... 6.7

SENSe:AVERage:COUNt:AUTO:TYPE[?] RESolution | NSRatio 6.7

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SENSe:AVERage:TCONtrol[?] MOVing | REPeat 6.8

SENSe:CORRection:DCYCle[?] 0.001 to 99.999 ..... 6.8

SENSe:CORRection:DCYCle:STATe[?] OFF | ON 6.8

SENSe:CORRection:OFFSet[?] –200.0 to 200.0 ..... 6.9

SENSe:CORRection:OFFSet:STATe[?] OFF | ON 6.9

SENSe:FREQuency[?] 10.0e3 to 18.0e9 (R&S NRP-Z27) or 26.5e9 (R&S NRP-Z37) 6.9

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SENSe:POWer:AVG:APERture[?] 0.001 to 0.3 ..... 6.10

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6 Remote Control – Commands

Notation

In the following sections, all commands implemented in the power sensor module are first listed in a table according to command systems and are then described in detail. The notation is largely in line with the SCPI standard.

Command tables For a quick overview of available commands, the commands are listed in a table before they are described. These tables contain the following four columns:

Command:	Commands and their tree structure.
Parameters:	Possible parameters.
Unit:	The basic unit of the physical parameters (must not be sent with parameters).
Remarks:	Identification of all commands • that have no query form • that are available as query only

Indentations The various levels of the SCPI command hierarchy are shown in the table by indentations to the right. The lower the level, the greater the indentation to the right. It should be noted that the complete notation of the command includes the higher levels too.

Example:
SENSe:AVERage:COUNt is represented in the table as follows:

SENSe	first level
:AVERage	second level
:COUNt	third level

In the individual description, the command is shown in full length. An example of the command is given at the end of the description.

[?]
? A question mark in square brackets at the end of a command indicates that this command can either be used as a setting command (without question mark) or as a query (with question mark). If the question mark is not in square brackets, the command is a query only.

Example:
SENSe:POWer:AVG:APERture[?]
SENSe:POWer:AVG:APERture 1e-3 sets the length of the sampling window to 1 ms.

SENSe:POWer:AVG:APERture? Returns the currently set length as a response.
**IDN?* Queries the identification string of the power sensor module that of course cannot be changed. For this reason, this command is only available as a query.

Special characters | for parameters A vertical bar between parameters is used to separate alternative options (OR link).

Example:
NITiate:CONTinuous OFF | ON
The parameter *OFF* or *ON* can be entered.

{numeric expression} A numeric expression in braces means that it has been rounded to the nearest integral value.

<parameter> <variable> A parameter or a variable in triangular brackets expresses its current value.

Commands as per IEEE 488.2

The power sensor module supports a subset of the possible setting commands and queries *(Common Commands and Queries)* in line with IEEE 488.2.

*IDN? – Identification Query

**IDN?* returns a string with information on the power sensor module's identity (device identification code). In addition, the version number of the installed firmware is indicated. The string for a power sensor module of type R&S NRP-Z27/-Z37 has the following structure:

ROHDE&SCHWARZ,NRP-Zx7,<serial number>,<firmware version>

<serial number>: Serial number in ASCII
<firmware version>: Firmware version number in ASCII

*RST – Reset

**RST* sets the power sensor module to the default state, i.e. the default settings for all test parameters are loaded.

*TRG – Trigger

**TRG* triggers a measurement. For this purpose, the power sensor module is in the *WAIT_FOR_TRIGGER* state and the source for the trigger event is set to *BUS* (*TRIGger:SOURce BUS*).

*TST? – Self Test Query

**TST?* starts a selftest and returns 0 (no error found) or 1 (an error has occurred). The selftest comprises the following functions:

- RAM test
- Operating voltages
- Temperature measurement
- Calibration data set
- Noise
- Zero-point offsets.

SCPI Commands

The power sensor module R&S NRP-Z27/-Z37 is controlled via the groups of commands

- CALibration (zeroing)
- SENSe (measurement configurations)
- SYSTem
- TRIGger
- SERVice.

CALibration

Table 6-1 Commands of the *CALibration* system

Command	Parameter	Unit	Remarks
CALibration			
:DATA[?]	<calibration data set as definite length block>		
:LENGth?		Bytes	Query only
:ZERO			
:AUTO[?]	OFF | ON | ONCE		

CALibration:DATA[?] <calibration data set as *definite length block*>

CALibration:DATA is used for writing a calibration data set in the flash memory of the power module sensor.

The query yields the calibration data set currently stored in the flash memory as a *definite length block*.

CALibration:DATA:LENGth?

CALibration:DATA:LENGth? yields the length in bytes of the calibration data set currently stored in the flash memory. Programs that read out the calibration data set can use this information to determine the capacity of the buffer memory required.

CALibration:ZERO:AUTO[?] OFF | ON | ONCE

The commands *CALibration:ZERO:AUTO ON* and *CALibration:ZERO:AUTO ONCE* perform zeroing. For this purpose, the test signal must be deactivated or the power sensor module disconnected from the signal source. The power sensor module automatically detects the presence of any significant power to be measured. This causes zeroing to be aborted and error message *NRPERROR_CALZERO* to be output. The *CALibration:ZERO:AUTO OFF* is ignored. Zeroing takes four seconds at a minimum, but at least as long as the selected averaging filter needs for settling (only fixed-filter mode).

Repeat zeroing

- *during warm-up after switching on or connecting the instrument*
- *after a substantial variation of the ambient temperature*
- *after fastening the power sensor module to an RF connector at high temperature*
- *after several hours of operation*
- *when very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.*

For zeroing switch off the test signal and do not remove the power sensor module from the signal source. Apart from keeping the thermal balance, this has the advantage that the noise superimposed on the test signal (e.g. from a broadband amplifier) can be detected on zeroing and does not impair the measurement result.

The query always yields *1* (= *OFF*).

Default setting
After a power-on reset, the zero offsets determined during the last calibration are used until the first zeroing. Therefore, very slight zero offsets are to be expected with a warmed up power sensor module. Initialization by means of **RST* or *SYSTem:INITialize* has no influence on the current zero offsets.

SENSe (Power Sensor Module Configuration)

The power sensor module is configured by means of the commands of the groups *SENSe* and *TRIGger*.

Table 6-2 Commands of the *SENSe* system

Command	Parameter	Unit	Remarks
SENSe			
:AVERage			
:RESet			No query
:STATe[?]	OFF | ON		
:TCONtrol[?]	MOVing | REPeat		
:COUNt[?]	1 to 65536		
:AUTO[?]	OFF | ON | ONCE		
:TYPE[?]	RESolution | NSRatio		
:MTIMe[?]	1.0 to 999.99	s	
:NSRatio[?]	0.0001 to 1.0	dB	
:RESolution[?]	1 to 4		
:CORRection			
:OFFSet[?]	-200.0 to 200.0	dB	
:STATe[?]	OFF to ON		
:DCYCle[?]	0.001 to 99.999	%	
:STATe[?]	OFF to ON		
:FREQuency[?]	1.0e3 to 18.0e9 (NRP-Z27) or 26.5e9 (NRP-Z37)	Hz	
:FUNCtion[?]	"POWer:AVG"		
:POWer			
:AVG			
:APERture[?]	0.001 to 0.3	s	
:BUFFer			
:STATe[?]	OFF | ON		
:SIZE[?]	1 to 1024		

Command	Parameter	Unit	Remarks
:SMOothing:STATe[?]	OFF | ON		
:SGAMma			
:CORRection:STATe[?]	OFF | ON		
:MAGNitude[?]	0.0 to 1.0		
:PHASe[?]	-360.0 to 360.0	degree	
:RGAMma			
:MAGNitude[?]	0.0 to 1.0		
:PHASe[?]	-360.0 to 360.0		

SENSe:AVERage:COUNt[?] 1 to 65536

SENSe:AVERage:COUNt sets the number of measured values that have to be averaged for forming the measurement result. The higher this averaging factor, the less the measured values fluctuate and the longer the measurement time lasts. The parameter is rounded off to the nearest power-of-two number.

The query yields the averaging factor used.

The averaging function must be activated with SENSe:AVERage:STATe ON *so that the set averaging factor becomes effective.*

Default setting: *4*

SENSe:AVERage:COUNt:AUTO[?] OFF | ON | ONCE

SENSe:AVERage:COUNt:AUTO activates (auto-averaging) or deactivates (fixed-filter mode) automatic determination of the averaging factor. If auto-averaging is activated, the averaging factor is continuously determined and set depending on the level of power and other parameters.

SENSe:AVERage:COUNt:AUTO ON activates auto-averaging and *SENSe:AVERage:COUNt:AUTO OFF* deactivates it. On deactivation, the previous, automatically determined averaging factor is used in the fixed-filter mode. The *SENSe:AVERage:COUNt:AUTO ONCE* command ensures that a new averaging factor is determined by the filter automatic function under the current measurement conditions and used in the fixed-filter mode.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

SENSe:AVERage:COUNt:AUTO:MTIMe[?] 1.0 to 999.99

SENSe:AVERage:COUNt:AUTO:MTIMe sets the settling time upper limit of the averaging filter in the auto-averaging mode and limits the length of the filter.

The query yields the current settling time upper limit of the averaging filter.

Default setting: *30.0 [s]*

SENSe:AVERage:COUNt:AUTO:NSRatio[?] 0.0001 to 1.0

SENSe:AVERage:COUNt:AUTO:NSRatio determines the relative noise component in the measurement result if auto-averaging is operated in the corresponding mode (*SENSe:AVERage:COUNt:AUTO:TYPE NSRatio*). The noise component is defined as the magnitude of the level variation in dB caused by the inherent noise of the power sensor module (two standard deviations).

The query yields the relative noise component in the result.

Default setting: *0.01 [dB]*

SENSe:AVERage:COUNt:AUTO:RESolution[?] 1 to 4

SENSe:AVERage:COUNt:AUTO:RESolution sets the resolution index for the automatic averaging filter. The resolution index equals the number of decimal places that have to be taken into account for the further processing of the measurement result in dBm, dBµV or dB. The normal mode is designed in a similar manner as for the predecessors R&S NRVS and R&S NRVD or other commercial power meters. The higher the selected index, the better the measurement result is filtered without the last significant place (0.01 dB with an index of 3) actually being set. The NSRatio setting is recommended instead.

The query yields the resolution index.

Default setting: *3*

SENSe:AVERage:COUNt:AUTO:TYPE[?] RESolution | NSRatio

SENSe:AVERage:COUNt:AUTO:TYPE defines the automatic averaging filter mode. The *RESolution* parameter sets the mode usual for power meters; *NSRatio* predefines the compliance to an exactly defined noise component.

The query yields
- *1* for *RESolution*,
- *2* for *NSRatio*.

Default setting: *RESolution*

SENSe:AVERage:RESet

SENSe:AVERage:RESet initializes the averaging filter. This is useful if a high averaging factor is set in the *SENSe:AVERage :TCONtrol MOVing* filter mode and if the power to be measured has significantly decreased since the previous measurement, e.g. by several powers of ten. In this case, previous measurement results still contained in the averaging filter strongly affect the settling of the display; as a result, the advantage of the *SENSe:AVERage:TCONtrol MOVing* filter mode, i.e. the ability to detect trends in the measurement result while the measurement is still in progress, is lost. The *SENSe:AVERage:RESet* command solves this problem by deleting all previous measurement results that the averaging filter contains. After initialization, the filter length gradually increases from 1 to its nominal value *SENSe:AVERage:COUNt*, so that trends in the measurement result become quickly

apparent. However, this procedure does not shorten the measurement time required in order for the averaging filter to settle completely.

SENSe:AVERage:STATe[?] OFF | ON

SENSe:AVERage:STATe switches on or off the averaging filter.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *ON*

SENSe:AVERage:TCONtrol[?] MOVing | REPeat

SENSe:AVERage:TCONtrol (terminal control) defines the behaviour of the averaging filter. As soon as a new measured value is shifted to the FIR filter, a new average value is available at the filter output, which is obtained from the new measured value and the other values stored in the filter.

The *MOVing* parameter defines that each new average value is output as a measurement result. This allows tendencies in the result to be recognized during the measurement procedure.

The *REPeat* parameter defines that a new result is output after the FIR filter has been filled with new measured values. This ensures that no redundant information is output.

The query yields
- *1* for *MOVing*,
- *2* for *REPeat*.

Default setting: *MOVing*

SENSe:CORRection:DCYCle[?] 0.001 to 99.999

SENSe:CORRection:DCYCle sets the duty cycle to a percent value for the correction of pulse-modulated signals. With the correction activated, the power sensor module calculates the signal pulse power from this value and the mean power.

The query yields the current duty cycle in percent.

Default setting: *1.0 [%]*

SENSe:CORRection:DCYCle:STATe[?] OFF | ON

SENSe:CORRection:DCYCle:STATe ON activates the duty cycle correction and thus the pulse-power measurement whereas *SENSe:CORRection:DCYCle:STATe OFF* deactivates it.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

SENSe:CORRection:OFFSet[?] –200.0 to 200.0

SENSe:CORRection:OFFSet defines a fixed offset in dB, which is used to correct the measured value. (When a log scale is used, the offset is added to the measured value; this is the reason why the command has this name.)

The attenuation of an attenuator located ahead of the power sensor module or the coupling attenuation of a directional coupler is taken into account with a positive offset, i.e. the power sensor module calculates the power at the input of the attenuator or directional coupler. A negative offset can be used to correct the influence of a gain connected ahead.

The query yields the set offset in dB.

Default setting: *0.0 [dB]*

SENSe:CORRection:OFFSet:STATe[?] OFF | ON

SENSe:CORRection:OFFSet:STATe ON activates the offset correction and *SENSe:CORRection:OFFSet:STATe OFF* deactivates it.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

SENSe:FREQuency[?] 10.0e3 to 18.0e9 (R&S NRP-Z27) or 26.5e9 (R&S NRP-Z37)

SENSe:FREQuency transfers the carrier frequency of the RF signal to be measured; this frequency is used for the frequency-response correction of the measurement result. The center frequency is set for broadband signals (*spread-spectrum* signals, multicarrier signals).

The query yields the set carrier frequency in Hz.

Default setting: *50.0e6 [Hz]*

SENSe:FUNCtion[?] <sensor_function>

In contrast to other sensors of the R&S NRP-Z series, the power sensor modules only implement the *Continuous Average* mode. Therefore, the command *SENSe:FUNCtion <sensor_function>* only accepts the parameter *"POWer:AVG"*.

Table 6-3 Measurement mode "POWer:AVG"

<sensor_function>	Description of the measurement mode
"POWer:AVG"	**Continuous Average** After occurrence of the trigger event, the mean power is measured in a time interval (sampling window) whose width is defined with SENSe:POWer:AVG:APERture. The single measurements are performed in pairs to obtain a more accurate measurement result by differentiation. With the averaging function activated, this operation is repeated the number of times specified by the averaging factor. With the averaging function activated, the actual measurement time is thus 2 × <SENSe:AVERage:COUNt> × <SENSe:POWer:AVG:APERture> and with deactivated averaging function 2 × <SENSe:POWer:AVG:APERture>. Trigger events start one or several measurements in the Continuous Average mode (depending on the TRIGger:COUNt parameter).

The query always yields *1* for *"POWer:AVG"*.

Default setting: *"POWer:AVG"*

SENSe:POWer:AVG:APERture[?] 0.001 to 0.3

SENSe:POWer:AVG:APERture defines the time interval (sampling window); measured values are continuously recorded in this interval. In manual operation, the default setting of 20 ms in conjunction with the activated smoothing (see *SENSe:POWer:AVG:SMOothing:STATe*) is sufficient in most cases. Another value, which is normally higher, is required when the measurement result shows variations due to modulation. Especially with low-frequency modulation, it is useful to adapt the size of the sampling window exactly to the modulation period, which yields an optimum stable display.

Table 6-4 Optimum selection of the sampling window size (N = 1, 2, 3, ...)

Smoothing	Optimum sampling window size
OFF	N × modulation period / 2
ON	N × modulation period × 2

The theoretically shortest measurement time can then be obtained only with smoothing deactivated. The situation is somewhat different when the sampling window cannot or should not be exactly adapted to the modulation period. Smoothing should then be activated since even one measurement window length of 5 periods is sufficient to reduce variations due to modulation to an acceptable extent; variations are no longer perceptible with more than 9 periods. With smoothing deactivated, the situation is significantly unfavourable. In this case, 5 instead of 300 periods are required and the variations completely disappear as of 3000 periods.

The query yields the currently set width of the sampling window in seconds.

Default setting: *0.02 [s]*

SENSe:POWer:AVG:BUFFer:SIZE[?] 1 to 1024

SENSe:POWer:AVG:BUFFer:SIZE sets the buffer size for the buffered *Continuous Average* mode.

The query yields the current buffer size for the buffered *Continuous Average* mode.

Default setting: *1*

SENSe:POWer:AVG:BUFFer:STATe[?] OFF | ON

The buffered *Continuous Average* mode is activated with *ON* and deactivated with *OFF*. In this mode, the results generated by trigger events are collected in the power sensor module until the buffer is filled. All results are then transferred as block data. The measurement rate obtained is thus higher than in the non-buffered *Continuous Average* mode. The maximum measurement rate is obtained by combining the buffered mode with multiple triggering (see parameter *TRIGger:COUNt*). The size of the result buffer is set with the *SENSe:POWer:AVG:BUFFer:SIZE* command.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

SENSe:POWer:AVG:SMOothing:STATe[?] OFF | ON

The *ON* parameter activates a smoothing filter for modulated signals in the *Continuous Average* mode and *OFF* deactivates it. The smoothing filter is a steep-edge digital lowpass filter used to suppress variations of results caused by low-frequency modulation. This parameter should be activated to reduce variations in results due to modulation when the size of the sampling window cannot or should not be exactly adapted to the modulation period. If the selected sampling window is 5 to 9 times larger than a modulation period, the variations in display are normally sufficiently reduced. With smoothing deactivated, 300 to 3000 periods are required to obtain the same effect.

With smoothing deactivated, the sampling values are considered equivalent and averaged in a sampling window, which yields an integrating behaviour of the measuring instrument. As described above, optimum suppression of variations in the result is thus obtained when the size of the sampling window is exactly adapted to the modulation period. Otherwise, the modulation can have a considerable influence, even if the sampling window is much larger than the modulation period. The behaviour can be considerably improved by subjecting sampling values to weighting (raised-von-Hann window), which corresponds to video filtering. This is exactly what happens with activated smoothing.

Since the smoothing filter increases the inherent noise of the power sensor module by approx. 20 %, it should remain deactivated if it is not required.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *ON*

SENSe:SGAMma:CORRection:STATe[?] OFF | ON

SENSe:SGAMma:CORRection:STATe ON activates the correction of the mismatch (gamma correction) between the power sensor module and the source. Gamma correction ensures that the power of the source available at 50 Ω is measured, whereas without correction only the power of the arriving wave is measured. For gamma correction, the complex reflection coefficient of the source is necessary (settings *SENSe:SGAMma:MAGNitude* und *SENSe:SGAMma:PHASe*).

The query yields
- *1* for *OFF,*
- *2* for *ON.*

Default setting: *OFF*

SENSe:SGAMma:MAGNitude[?] 0.0 to 1.0

SENSe:SGAMma:MAGNitude defines the magnitude of the complex reflection coefficient of the source. A value of *0.0* corresponds to an ideal matched source and a value of 1.0 to total reflection.

The query yields the set magnitude.

Default setting: *0.0*

SENSe:SGAMma:PHASe[?] –360.0 to 360.0

SENSe:SGAMma:MAGNitude defines the phase angle (in degrees) of the complex reflection coefficient of the source.

The query yields the set phase angle.

Default setting: *0.0 [°]*

SENSe:RGAMma:MAGNitude[?] 0.0 to 1.0

With the *SENSe:RGAMma* group of commands, you can compensate the load distortion at the signal output. Such compensation is necessary if the standing wave ratio exceeds a value of 1.05. Otherwise, you cannot comply with the data sheet specifications with regard to absolute accuracy.

For distortion compensation, you have to transfer the magnitude of the reflection coefficient of the load with the setting *SENSe:RGAMma:MAGNitude* and the phase angle with the setting *SENSe:RGAMma:PHASe.* To deactivate distortion compensation, set *SENSe:RGAMma:MAGNitude* to 0. An explicit switch-on/-off command, as is available in mismatch correction, does not exist. Distortion compensation should remain deactivated in the case of questionable measurement values for the reflection coefficient of the load.

The query yields the set magnitude.

Default setting: *0.0*

SENSe:RGAMma:PHASe[?] –360.0 ... 360.0

SENSe:RGAMma:PHASe defines the phase angle (in degrees) of the complex reflection factor of the load at the signal output.

The query yields the set phase angle.

Default setting: *0.0 [°]*

SYSTem

With the aid of the *SYSTem* system, administrative device settings can be defined and queried. This includes detailed information on the power sensor module and its initialization and the transfer of available commands and their parameter limits.

Table 6-5 Commands of the *SYSTem* system

Command	Parameter	Unit	Remarks
SYSTem			
:INFO? [Item]			Query only
:INITialize			No query
MINPower?		W	Query only
:TRANsaction			
:BEGIN:			No query
:END			No query

SYSTem:INFO? [Item]

SYSTem:INFO? yields a string containing information that is more detailed than the identification string delivered by the power sensor module as a response to **IDN?*. If no *Item* is specified, the response string is a sequence of entries in the form *Item:Information-String* separated by *CR* and *LF* (in C notation: *\r\n*). With the *Item* optionally appended to the command, the entry for the required *Item* can be queried. The response string is zero-terminated, i.e. its end identification is a zero byte (in C notation: *\0*).

Table 6-6 Meaning of *Item* in the *SYSTem:INFO?* command

Item	Information string	Remarks
"MANUFACTURER"	"Rohde & Schwarz GmbH & Co. KG"	Manufacturer
"TYPE"	"NRP-Z27" for R&S NRP-Z27" "NRP-Z37" for R&S NRP-Z37"	Type designation
"STOCK NUMBER"	"1169.4102.02" for R&S NRP-Z27" "1169.3206.02" for R&S NRP-Z37"	Material number
"SERIAL"	"<serial number>"	6-digit serial number
"HWVERSION"	"000000000"	Hardware version (standard)
"HWVARIANT"	"000000000"	Hardware model (standard)
"SW BUILD"	"<build number>"	Version number of firmware
"TECHNOLOGY"	"Thermal"	Detector technology used

Item	Information string	Remarks
"FUNCTION"	"Power Terminating"	Operating principle of a terminating power sensor.
"MINPOWER"	"<nominal lower test limit in W>"	The nominal lower test limit of power sensor modules is 4 µW, i.e. with information string "4e-6" as a response to *SYSTem:INFo? "MINPOWER"*.
"MAXPOWER"	"<nominal upper test limit in W>"	The nominal upper test limit of power sensor modules is 400 mW, i.e. with information string "0.4" as a response to *SYSTem:INFo? "MAXPOWER"*.
"MINFREQ"	"<min. measuring frequency in Hz>"	The minimum measuring frequency is 1 kHz, i.e. the power sensor module returns the information string "1e+03" as a response to *SYSTem:INFo? "MINFREQ"*.
"MAXFREQ"	"<max. measuring frequency in Hz>"	The maximum measuring frequency is 18 GHz for the R&S NRP-Z27, or 26.5 GHz for the R&S NRP-Z37, i.e. the power sensor module returns the information string "1.8e+10" or "2.65e+10", respectively, as a response to *SYSTem:INFo? "MAXFREQ"*.
"IMPEDANCE"	"50"	The R&S NRP-Z5x RF input has a nominal input impedance of 50 Ω.
"COUPLING"	" DC"	The RF input of the power sensor modules is DC-coupled.
"CAL. ABS."	"<date>"	Date of absolute calibration in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"CAL. REFL."	"<date>"	Date of matching calibration in the format YYYY-MM-DD.
"CAL. S PARA."	"<date>"	Date of s-parameter calibration in the format YYYY-MM-DD. If no S parameter set is loaded, the sensor returns the string "not applicable". "Invalid Calibration Date" is returned with an invalid date entry.
"CAL. MISC."	"<date>"	Date of the calibration of other parameters in the format YYYY-MM-DD. "Invalid Calibration Date" is returned with an invalid date entry.
"SPD MNEMONIC"	"<mnemonic string>"	Clear-text designation of the component connected ahead of the power sensor (e.g. "splitter)

SYSTem:INITialize

SYSTem:INITialize sets the power sensor module to the standard state, i.e. the default settings for all test parameters are loaded in the same way as with **RST*. The power sensor module then outputs a complete list of all supported commands and parameters. With the command, the remote-control software can automatically adapt to the features of different types of sensors with different functionality.

SYSTem:MINPower?

SYSTem:MINPower? yields the lower test limit of the power sensor module. This query can be used to determine a useful resolution for the result display near the lower test limit.

SYSTem:TRANsaction:BEGin

SYSTEM:TRANsaction:BEGin marks the beginning of a sequence of setting commands between which the parameter limits must not be checked. This prevents the display of error messages when a setting command causes a conflict that is resolved by a subsequent setting command. See *SYSTEM:TRANsaction:END*.

SYSTem:TRANsaction:END

SYSTEM:TRANsaction:END marks the end of a sequence of setting commands between which the parameter limits must not be checked. After this command, the parameter limits are checked.

TEST

Table 6-7 Commands of the *TEST* system

Command	Parameter	Unit	Remarks
TEST:SENSor?			Query only

TEST:SENSor?

TEST:SENSor? triggers a selftest of the power sensor module. In contrast to **TST*, this command yields detailed information, which is useful for troubleshooting.

No signal may be applied to the power sensor module while the selftest is running.

If the selftest is carried out with a signal being present, error messages may erroneously be output for the test steps "Offset Voltages" and/or "Noise Voltages".

TRIGger

Table 6-8 Commands of the *TRIGger* system

Command	Parameter	Unit	Remarks
ABORt			No query
INITiate			
:CONTinuous[?]	OFF | ON		
:IMMediate			No query
TRIGger			
:COUNt[?]	1 to 2×10^9		
:DELay[?]	x to 100.0	s	
:AUTO[?]	OFF | ON		
:HOLDoff[?]	0.0 to 10.0	s	
:HYSTeresis[?]	0.0 to 3.0	dB	
:IMMediate			No query
:LEVel[?]	x to y	W	
:SLOPe[?]	POSitive | NEGative		
:SOURce[?]	BUS | EXTernal | HOLD | IMMediate | INTernal		

ABORt

ABORt interrupts the current measurement and sets the power sensor module to the *IDLE* state (normal case). However, if the power sensor module is in the continuous measurement mode (setting *INITiate:CONTinuous ON*), the *IDLE* state is immediately exited and the power sensor module enters the *WAIT_FOR_TRIGGER* state.

INITiate:CONTinuous[?] OFF | ON

INITiate:CONTinuous ON activates the continuous measurement mode. In this mode, a new measurement is automatically started when a measurement is terminated. The power sensor module first enters the *WAIT_FOR_TRIGGER* state and begins with the measurement as soon as the trigger condition is fulfilled. Once the measurement is completed, the sensor again enters the *WAIT_FOR_TRIGGER* state. The power sensor module will measure continuously assuming continuous trigger events.

In contrast, each measurement cycle must be explicitly started with the *INITiate:IMMediate* command after the *INITiate:CONTinuous OFF* command has been sent. After triggering and completion of the measurement, the power sensor module enters the *IDLE* status and remains in this status until a new measurement is started with the *INITiate:IMMediate* command.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *OFF*

INITiate:IMMediate

INITiate:IMMediate starts a single measurement cycle. The power sensor module first changes from the *IDLE* state to the *WAIT_FOR_TRIGGER* state and begins with the measurement as soon as the trigger condition is fulfilled. Once the measurement is completed, the sensor again enters the *IDLE* state. Since the command is ignored during measurement, it normally has no effect in the continuous mode (setting *INITiate:CONTinuous ON*).

TRIGger:COUNt[?] 1 to 2×10^9

This setting is designed for applications in which several consecutive measurements have to be performed by sending the *INITiate:IMMediate* command only once, e.g. to obtain a higher measurement speed. The gap between a single measurement and the continuous measurement mode is thus closed. The number of measurements is defined with the parameter associated with the *TRIGger:COUNt* command. This number equals the number of results yielded by the power sensor module at the end of the measurement.

The TRIGger:COUNt *command does not define the number of trigger events required for performing the entire measurement task. The number may vary depending on the measurement mode.*

A further increase in the measurement speed can be obtained by combining the mode used with the buffered mode. The results are not made available immediately but as a block at the end of the measurement sequence (see group commands SENSe:POWer:AVG:BUFFer).

The query yields the number of measurements performed with the *INIT:IMMediate* command after a measurement start.

Default setting: *1*

TRIGger:DELay[?] 0 to 100.0

TRIGger:DELay defines the delay (in seconds) between the occurrence of the trigger event and the beginning of the measurement itself.

The query yields the set trigger delay (in seconds).

Default setting: *0.0 [s]*

TRIGger:DELay:AUTO[?] OFF | ON

TRIGger:DELay:AUTO ON ensures by means of an automatically determined delay that a measurement is only started after the test result has settled. This is important when thermal power sensor modules are used. The automatically determined delay is ignored if a longer period was set with *TRIGger:DELay*. This does not overwrite the value of *TRIGger:DELay*. *TRIGger:DELay:AUTO OFF* deactivates this function.

The query yields
- *1* for *OFF*,
- *2* for *ON*.

Default setting: *ON*

TRIGger:HOLDoff[?] 0.0 to 10.0

TRIGger:HOLDoff suppresses trigger events within the set holdoff time (in s), starting from the time of the last successful triggering.

The query yields the set holdoff time (in s).

Default setting: *0.0 [s]*

TRIGger:HYSTeresis[?] 0.0 to 10.0

TRIGger:HYSTeresis sets the hysteresis of the internal trigger threshold (parameter *TRIGger:LEVel*). Hysteresis is the magnitude (in dB) by which the trigger signal level falls below the trigger threshold (with positive trigger edge) to enable triggering again. The case is exactly the opposite with a negative trigger edge. The trigger hysteresis setting is only relevant to the *INTernal* trigger source.

The query yields the trigger hysteresis in dB.

Default setting: *0.0 [dB]*

TRIGger:IMMediate

TRIGger:IMMediate triggers a generic trigger event that causes the power sensor module to exit immediately the *WAIT_FOR_TRIGGER* state irrespective of the trigger source and the trigger delay and begin with the measurement. The command is the only means of starting a measurement when the trigger source is set to *HOLD*.

TRIGger:LEVel[?] x to y

TRIGger:LEVel sets the trigger threshold for internal triggering derived from the test signal (in W). This setting is irrelevant to all other trigger sources.

The query yields the trigger threshold in W.

Lower limit x and upper limit y of parameter

SENSe:CORRection:OFFSet:STATe OFF: x = 25 × <lower test limit>
y = <upper test limit >

SENSe:CORRection:OFFSet:STATe ON: x = 25 × < lower test limit > × 10^(<*SENSe:CORRection:OFFSet*> / 10)
y = < upper test limit > × 10^(<*SENSe:CORRection:OFFSet*> / 10)

< lower test limit >: 4.0e-6

< upper test limit >: 0.4

Default setting: 10 × x

TRIGger:SLOPe[?] POSitive | NEGative

TRIGger:SLOPe defines the edge of the trigger event with internal and external triggering. In this connection, positive means increasing envelope power (with internal triggering) or increasing voltage (with external triggering). This command has no effect in conjunction with trigger sources *BUS*, *HOLD* and *IMMediate*.

The query yields
- *1* for *POSitive*,
- *2* for *NEGative*.

Default setting: *POSitive*

TRIGger:SOURce[?] BUS | EXTernal | HOLD | IMMediate | INTernal

TRIGger:SOURce sets the trigger source.

- *BUS*: Triggering with command **TRG* or *TRIGger:IMMediate*.
- *EXTernal*: Triggering via USB Adapter R&S NRP-Z3. Relevant trigger parameters: *TRIGger:DELay* and *TRIGger:SLOPe*.
- *HOLD*: Triggering only with command *TRIGger:IMMediate*.
- *IMMediate*: Automatic triggering without explicit event.
- *INTernal*: Triggering by the measurement signal. Relevant trigger parameters: *TRIGger:LEVel, TRIGger:DELay* and *TRIGger:SLOPe*.

The query yields
- *1* for *BUS*,
- *2* for *EXTernal*,
- *4* for *HOLD*,
- *8* for *IMMediate*,
- *16* for *INTernal*.

Default setting: *IMMediate*

List of Remote-Control Commands

The remote-control commands have a syntax based on standard SCPI 1999.0, but they comply with it only to a limited extent.

Table 6-9 List of remote-control commands

Command	Parameter	Unit	Default setting	Page
*** Commands**				
*IDN?				6.2
*RST				6.2
*TRG				6.2
*TST?				6.2
CALibration Commands				
CALibration:DATA[?]	<calibration data set as definite length block>			6.3
CALibration:DATA:LENGth?		Bytes		6.3
CALibration:ZERO:AUTO[?]	OFF | ON | ONCE		OFF (fixed)	6.4
SENSe Commands				
SENSe:AVERage:COUNt[?]	1 to 65536		4	6.6
SENSe:AVERage:COUNt:AUTO[?]	OFF | ON | ONCE		ON	6.6
SENSe:AVERage:COUNt:AUTO:MTIMe[?]	1.0 to 999.99	s	30.0	6.7
SENSe:AVERage:COUNt:AUTO:NSRatio[?]	0.0001 to 1.0	dB	0.01	6.7
SENSe:AVERage:COUNt:AUTO:RESolution[?]	1 to 4		3	6.7
SENSe:AVERage:COUNt:AUTO:TYPE[?]	RESolution | NSRatio		RESolution	6.7
SENSe:AVERage:RESet				6.7
SENSe:AVERage:STATe[?]	OFF | ON		ON	6.7
SENSe:AVERage:TCONtrol[?]	MOVing | REPeat		REPeat	6.8
SENSe:CORRection:DCYCle[?]	0.001 to 99.999	%	1.0	6.8
SENSe:CORRection:DCYCle:STATe[?]	OFF | ON		OFF	6.8
SENSe:CORRection:OFFSet[?]	-200.0 to 200.0	dB	0.0	6.9

Command	Parameter	Unit	Default setting	Page
SENSe:CORRection:OFFSet:STATe[?]	OFF | ON		OFF	6.9
SENSe:CORRection:SPDevice:STATe[?]	OFF | ON		OFF (can be modified by the user)	6.9
SENSe:FREQuency[?]	10.0e6 to 18.0e9 (NRP-Z51) or 40.0e9 (NRP-Z55)	Hz	50.0e6	6.9
SENSe:FUNCtion[?]	"POWer:AVG"		"POWer:AVG"	6.10
SENSe:POWer:AVG:APERture[?]	0.001 to 0.3	s	0.02	6.10
SENSe:POWer:AVG:BUFFer:SIZE[?]	1 to 1024		1	6.11
SENSe:POWer:AVG:BUFFer:STATe[?]	OFF | ON		OFF	6.11
SENSe:POWer:AVG:SMOothing:STATe[?]	OFF | ON		ON	6.11
SENSe:SGAMma:CORRection:STATe[?]	OFF | ON		OFF	6.12
SENSe:SGAMma:MAGNitude[?]	0.0 to 1.0		0.0	6.12
SENSe:SGAMma:PHASe[?]	–360.0 to 360.0	degree	0.0	6.12
SYSTem Commands				
SYSTem:INFO? [Item]				6.13
SYSTem:INITialize				6.14
SYSTem:MINPower?		W		6.15
SYSTem:TRANsaction:BEGin				6.14
SYSTem:TRANsaction:END				6.15
Test Commands				
TEST:SENSor?				6.16
Triggersystem Commands				
ABORt				6.17
INITiate:CONTinuous[?]	OFF | ON		OFF	6.17
INITiate:IMMediate				6.18
TRIGger:COUNt[?]	1 to 2×10^9		1	6.18
TRIGger:DELay[?]	0 to 100.0	s	0.0	6.18
TRIGger:DELay:AUTO[?]	OFF | ON		OFF	6.18
TRIGger:HOLDoff[?]	0.0 to 10.0	s	0.0	6.19

Command	Parameter	Unit	Default setting	Page
TRIGger:HYSTeresis[?]	0.0 to 10.0	dB	0.0	6.19
TRIGger:IMMediate				6.19
TRIGger:LEVel[?]	x to y	W	10 × x	6.19
TRIGger:SLOPe[?]	POSitive | NEGative		POSitive	6.20
TRIGger:SOURce[?]	BUS | EXTernal | HOLD | IMMediate | INTernal		IMMediate	6.20
SERVice Commands				
SERVice:CALibration:TEMPerature	ONCE		OFF	
SERVice:CALibration:TEMPerature:DATA?		K	0.0	
SERVice:CALibration:TEST[?]			-1	
SERVice:CALibration:ZERO:NEG0?			1	
SERVice:CALibration:ZERO:POS0?			2	
SERVice:MVCorrection[?]	0 to 63		63	
SERVice:PARameter:RTEMp[?]	<float value>	K	0.0	
SERVice:PARameter:RNULL0[?]	<float value>	Ω	0.0	
SERVice:PARameter:RBAHN[?]	<float value>	Ω	0.0	
SERVice:PARameter:NREF[?]	<float value>		0.0	
SERVice:PARameter:ATHERM[?]	<float value>	K^{-1}	0.0	
SERVice:PARameter:BTHERM[?]	<float value>	K	0.0	
SERVice:PARameter:CTHERM[?]	<float value>	K^{-1}	0.0	
SERVice:PARameter:DTHERM[?]	<float value>	K^{-1}	0.0	
SERVice:PARameter:CJUNC[?]	<float value>	F	0.0	
SERVice:RCount[?]	1 to 32767		0	
SERVice:RESult[?]	0.0 to 1.0e6	W	0.0	
SERVice:SAMPle[?]	0 to 99999999		1000	
SERVice:TDEScriptor?				
SERVice:TDEScriptor:LENGth?		Bytes		
SERVice:UNLock	1234			

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Test and Measurement
Division

Service Instructions

1169.3906.82

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4 Firmware Update

Chapter 4 provides information on the firmware update. Descriptions enclosed with the firmware update can be filed here.

Installation of New R&S NRP-Z27/-Z37 Firmware

Use the Firmware Update program module to load new firmware. The module is part of the R&S NRP Toolkit that is supplied on a CD-ROM and enables you to update the boot loader and the application firmware.

The current firmware versions can be downloaded from the R&S homepage on the Internet, since the CD-ROM accompanying the power sensor modules contains the firmware status at the time of delivery.

Hardware and software requirements

The system requirements for a firmware update are the same as for the operation of the power sensor module on a PC (an update via the R&S NRP base unit is not possible):

- PC with free USB port.
- USB Interface Adapter R&S NRP-Z3 or R&S NRP-Z4.
- Operating system Windows™ 98, Windows™ ME, Windows™ 2000, or Windows™ XP.
- **The R&S NRP Toolkit software must already be installed on your PC.**
- One of the following files must be selected (depending on the software component to be updated):
  - `<Type>_Sensor<Version Number>.nrp` Application
  - `Bootloader_<Version Number>.nrp,` Boot loader

  The files are available in the \software\firmware\sensors directory of the CD-ROM.

Preparation

- Connect the power sensor module to the PC using one of the two USB interface adapters.
- If a second R&S NRP-Z power sensor or an R&S NRP is connected to the PC, unplug these devices from the PC.
- Shortly afterwards, the PC should have identified the new USB hardware and assigned the appropriate driver from the **R&S NRP Toolkit** to the power sensor module (brief message in a small window).

If you forgot to install the R&S NRP Toolkit beforehand, Windows will try in vain to find a USB driver for the power sensor module. If this happens, the R&S NRP-Zxx is highlighted by a yellow exclamation mark in the Windows device manager. In this case, proceed as follows:

- *Abort the dialog for driver installation.*
- *Install the R&S NRP Toolkit from the CD-ROM.*
  Then manually assign the USB driver from the toolkit to the power sensor module.
- *Go to Control Panel – Add/Remove Hardware and start the hardware assistant to search for new components.*
- *Mark the R&S NRP-Zxx in the list of hardware components and complete the driver installation.*
- *Unplug the power sensor module and reconnect it.*

Updating the application firmware

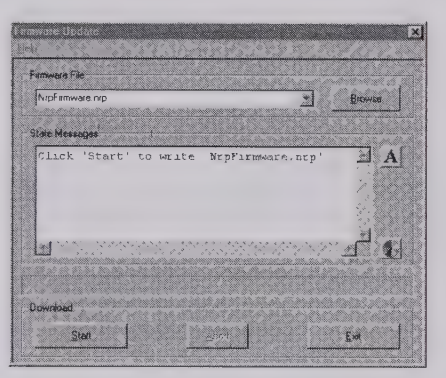
NRP_Z21_Messkopf_0 1_15.nrp

The update can be started as follows:

➢ Either double-click the icon of the update file named <Type>_Messkopf_<Version Number>.nrp

➢ Or start **NRP Toolkit – Firmware Update** from the Windows Start menu.

The dialog box on the left is displayed next.

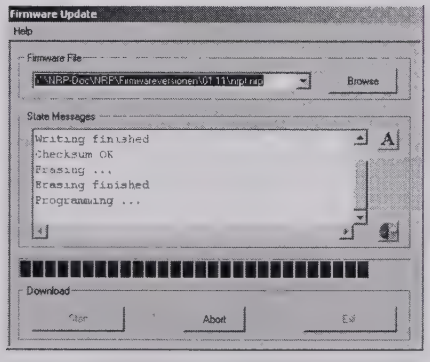


➢ If the update was started via the Windows Start menu, enter the file name of the application firmware in the **Firmware File** box (or search for the name by using the **Browse** button).

➢ Click the **Start** button to start the file transfer, which is performed automatically.

➢ Observe the following:

- *Do not disconnect the power sensor module from the PC.*
- *Neither connect nor disconnect the power supply for the R&S NRP-Z3 adapter.*
- *Exit the Firmware Update program only after it has been completely executed.*



➢ During the update, the State Messages box informs you of the progress. The update has been completed successfully if the message 'Device <Type Designation><Serial Number> is active' appears.

➢ You can then use the power sensor module for measuring.

Potential problems

- Error in the compatibility and consistency checks.

  In this case, the update is aborted and an error message is output.

➢ Unplug the power sensor module, reconnect it and start the update again.

Updating the boot loader

Bootloader_00_20.nrp

The boot loader update is similar to the update of the application firmware (see above).

➢ Instead of the application, however, you must load the new boot loader named

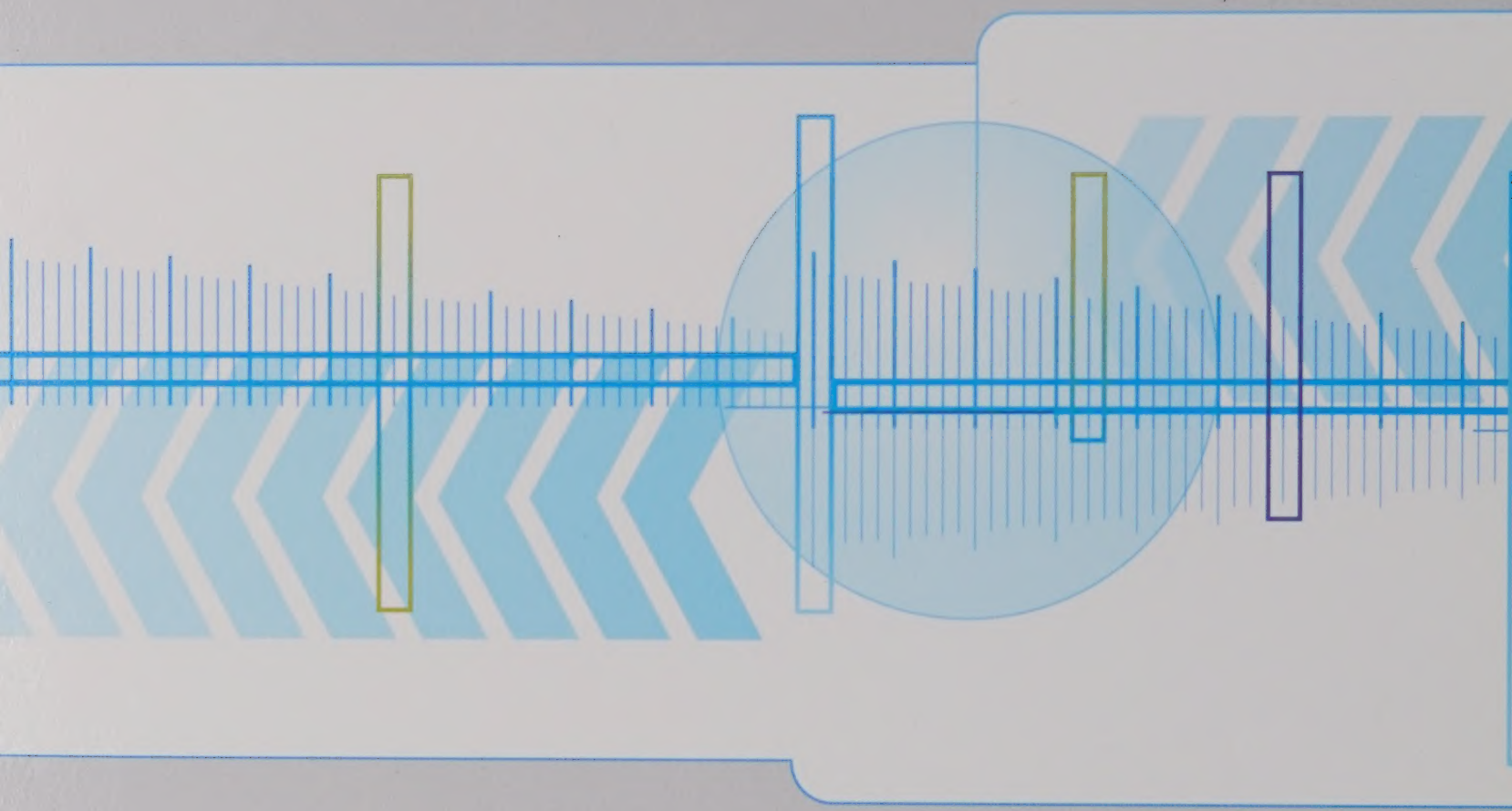
`Bootloader_<Version Number>.nrp`

Strictly observe the warnings under "Updating the application firmware", since the destruction of the boot loader will generally require a repair of the power sensor module.

Potential problems

- The power sensor module cannot be accessed after the update (error message).

➢ Exit the Firmware Update program, unplug the power sensor module from the PC and reconnect it. The power sensor module is now ready for operation.



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